THE UNIVERSITY OF ALBERTA

POSITIVE REINFORCEMENT STRATEGIES
IN AN
E.M.R. CLASSROOM

by

© JOHN BROWN MOFFITT

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1970

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Positive Reinforcement Strategies in an E.M.R. Classroom", submitted by John Brown Moffitt in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

A multiple baseline design was used in this study to investigate the effects of different positive reinforcement strategies upon classroom ecology in an E.M.R. setting. During the drill and practice session of daily math lessons at L. Y. Cairns School, baseline measures of on-task behavior, productivity, and accuracy were obtained for 15 students in class 1A and for 14 students in class 1B. A continuous record of individual performances was maintained as on-task behavior, productivity, and accuracy were successively influenced by the following conditions: non-contingent token reinforcement, contingent social reinforcement, and contingent token + social reinforcement (class 1A); and contingent token reinforcement and contingent token + social reinforcement (class 1B).

A single factor analysis of variance procedure was used to determine whether on-task behavior, productivity, and accuracy were differentially affected by the various reinforcement conditions. Where significant differences were found to exist, a Newman-Keuls test was employed to make comparisons at the .01 and .05 levels of significance.

Throughout the 8-week project, on-task behavior and productivity were significantly influenced by those conditions of reinforcement which were contingently applied. Academic accuracy, on the other hand, remained relatively unaffected during the short time the project was in operation. Optimum levels of on-task behavior and productivity

were maintained while the composite strategy of contingent token + social reinforcement was in effect. However, both component strategies, contingent token reinforcement and contingent social reinforcement, served to maintain levels of on-task behavior and productivity superior to those of baseline. Under the non-contingent token condition, on-task behavior and productivity both regressed to a point unprecedented during baseline.

Considerable variation was noted in the reactions of individual students to different conditions of reinforcement. Post checks of students' on-task behavior revealed that a high degree of generalization had been achieved up to two months after the termination of experimental conditions.

ACKNOWLEDGEMENTS

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Appreciation is also expressed to Dr. E. Fox, Dr. A. Neufeld, and Dr. L. Stewin for serving on the thesis committee. The author is indebted to Dr. G. Kysela for his boundless yet contingent guidance and assistance throughout every stage of this learning experience. Frances Rowe, who undertook the unenviable task of typing the final manuscript, has earned both my sympathy and respect.

The girl, whose understanding and unqualified support and inspiration made this thesis possible, is loved dearly.

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CHAPTER I

INTRODUCTION TO THE STUDY

I. BACKGROUND TO THE PROBLEM (A)

Learning has been defined as "the end product of the interaction between environmental experiences and predispositional states such as heredity and states of the central nervous system" (Quay, Werry, McQueen & Sprague, p509, 1966). Although these states may impose limits on the complexity of the interaction, environmental stimuli and reinforcement contingencies exert a major influence in determining individual behavioral repertoires.

If a teacher is responsible for providing an environment conducive to learning, then he is by definition a contingency manager or behavior modifier. In spite of the research which suggests that careful planning of contingencies can develop socially desirable behavior (Hart, Reynolds, Baer, Brawley & Harris, 1968); study behavior (Bushell, Wrobel & Michaelis, 1968); and high rates of academic accuracy (Nolen, Kunzelmann & Haring, 1967); a number of topical attitudes still impede the provision for contingent classroom environments. One such belief is that spontaneity and creativity are stifled by the imposition of contrived reinforcers. This feeling erroneously assumes that desirable behavior is intrinsically rewarding for all individuals regardless of their different reinforcement histories.

The alteration of undesirable behavior by contingency arrangement is sometimes regarded as bribery, yet teachers and parents will

readily attest that verbal instructions and requests so often have little enduring effect. O'Leary & Becker (1967) demonstrated that a mere knowledge of classroom rules failed to reduce disruptive behavior. Aversive bribery such as corporal punishment or loss of privileges is often the end product of futile attempts to change undesirable behavior through verbal means.

The notion of scientific determinism, which is basic to all operant procedures, is rejected by some because it is felt to violate basic human rights. Humanism has been defined as "any system or thought or action in which human interests, values and dignity predominate" (Ullman & Krasner, 1969, p. 599) If operant procedures can be instrumental in developing functional behavior repertoires of mental patients which ultimately lead to a reinstatement of their human rights, then surely such an endeavour is humanistic.

It is frequently overlooked that a loving or caring relationship has the potential to harm as well as help. Wolf, Risley & Mees, (1964) showed how temper tantrums were inadvertantly reinforced through the indiscriminate use of love and attention. Ayllon & Haughton (1962) demonstrated that consistent social attention was responsible for maintaining bizarre eating habits of mental patients.

Adherents to the unsubstantiated beliefs outlined above would demonstrate a greater concern for the individual welfare of children by being aware that reinforcement does operate to maintain both desirable and undesirable behavior.

Werry & Quay (1969) isolate perhaps the major reason for the

failure of classroom reinforcement efforts. They state that the concept of contingency is probably one of the most crucial factors in behavior modification and yet probably one of the least appreciated among those working with children.

II. THE PROBLEM (A)

Although accumulating evidence suggests that contingency management is of profound importance to classroom teachers, the systematic use of contingent reinforcement as a teaching aid, is not widespread. In view of this state of affairs, there is need to emulate the advantages of using contingent, over non-contingent reinforcement in the classroom. Consequently this study will investigate the effect of contingent and non-contingent reinforcement strategies on students' on-task behavior, productivity and academic accuracy.

III. BACKGROUND TO PROBLEM (B)

A variety of behavior modification procedures such as punishment (Barish, Saunders & Wolf, 1969); extinction (Zimmerman & Zimmerman, 1962); shaping (Wolf, et al., 1964); and positive reinforcement (Hall, Lund & Jackson, 1968), have been successfully employed to enhance learning.

Positive reinforcement, the most frequently reported procedure, has taken the form of primary reinforcers such as food (Ayllon & Haughton, 1962); secondary reinforcers such as tokens (Hill, 1970; Barish, et al., 1969; Hewett, Taylor, & Artuso, 1969) and social approval (Hart et al.,1968; Broden, Hall, Dunlop, & Clark, 1970)

Researchers using these procedures have been content to demonstrate the applicability of global classifications of reinforcement in modifying behavior. For example, social attention has been demonstrated to function as a powerful reinforcing agent of both disruptive behavior (Becker, Madsen, Arnold & Thomas, 1967) as well as desirable classroom behavior (Hall, et al., 1968). However, if social attention can be considered a constellation of different reinforcing stimuli such as smiles, praise, and approval, then a systematic analysis of the components of social reinforcement has not yet been undertaken.

Likewise,in the literature reporting token reinforcement programs, attempts to evaluate the components of the reinforcement operating have been conspicuously absent. Patterson, Jones, Whittier & Wright's (1965) study of the effectiveness of token reinforcement on the task attention of a hyperactive school child, clearly demonstrates this oversight. The study reports that a child's increased attending behavior failed to return to baseline level once the token reinforcement was discontinued. The authors attributed this unexpected result to the social reinforcement awarded by the child's classmates. Because no attempt was made to account for this social reinforcement, it is difficult to separate the effects of candy and pennies from the effect of peer reinforcement.

From a review of literature available on classroom token reinforcement programs, no study has sought to investigate the separate effects of the two components, social reinforcement and token

reinforcement as distinct from token plus social reinforcement. Although most classroom token studies have included social reinforcement as a common variable in both baseline and experimental phases (O'Leary, Becker, Evans, Saudergas, 1969; Birnbrauer, Wolf, Kidder & Tague, 1965; Hewett, et al., 1969), it seems questionable whether the effects of token and social reinforcement are simply additive.

IV. THE PROBLEM (B)

A review of current literature on the contingent use of extrinsic reinforcement indicates the need to systematically evaluate the effect of contingent social reinforcement, contingent token reinforcement, and contingent token plus social reinforcement on crucial classroom behaviors.

CHAPTER II

REVIEW OF RELATED LITERATURE

I. THE THEORETICAL MODEL

The intentional development, maintenance, and extinction of specific behavior has been conclusively demonstrated in the operant laboratory. The basic model used to explain the interaction between an organism and its environment in such a setting is made up of three components.

The occasion upon which a response occurs → The response itself → The reinforcing consequences

Skinner (1969. p. 7) refers to the interrelationships among these three elements as the "contingencies of reinforcement".

Even though good teachers have arranged contingencies in the past to facilitate learning, it is only in the last decade that systematic arrangements have been planned according to a sound theoretical model. The budding practice of applying operant principles to problems in the natural environment is often mistakably referred to as "operant conditioning". "Applied behavior analysis" (Baer, Wolf & Risley, 1968); "behavioral engineering" (Homme, C'de Baca, Collingham & Homme, 1968); behavior modification (Tharp & Wetzel, 1969); and "precision teaching" (Kunzelmann, 1970); are a sample of procedures which systematically apply the principles of the operant conditioning model to behaviors in the natural environment. Homme, et al (1968) suggest that the term "operant conditioning" should be reserved for the

laboratory science from which these techniques have been derived.

II. THE APPLIED MODEL

The operant conditioning model employed in a laboratory setting where deprivation states can be purposely manipulated, is not fully applicable in the natural environment because behavioral change agents working with everyday problems are unable to effect the same degree of control over behaviors as can be assumed by operant conditioners in the laboratory. Homme et al., (1968) proposed a "Behavioral Engineering" model which incorporates the essential elements of the operant conditioning model, yet which lends itself ideally to intervention procedures in the natural environment.

THE APPLIED MODEL OF BEHAVIORAL ENGINEERING

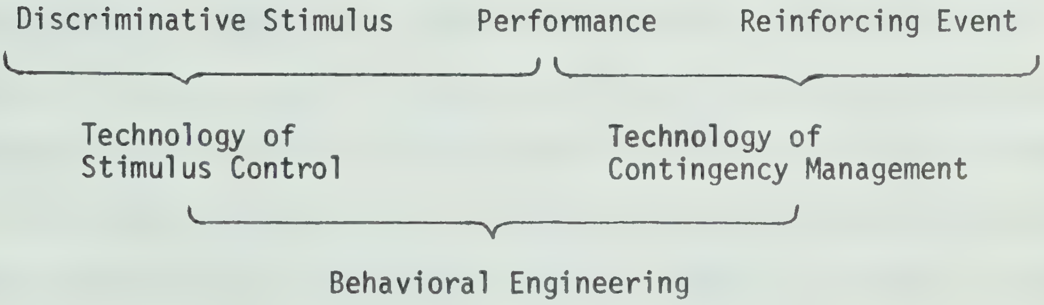

Figure 1. Relationship between the three term contingency and behavioral engineering (Homme et al., 1968, p. 426)

Homme's model perceives behavioral engineering as a combination of two technologies, the technology of stimulus control and the technology of contingency management.

Component I: Stimulus Control

Stimulus control exists to the extent that the presence or absence of a stimulus controls the probability of a response. Discriminative stimuli come to acquire a degree of control over behavior, not to the extent that they elicit the behavior but, that they set the occasion for a particular response to be emitted. For example, the presence of a police officer at a busy intersection will prompt one to obey traffic regulations on that occasion. It is important to realize that a particular event may serve as a discriminative stimulus in one situation and a reinforcing stimulus in another. The appropriate classification is based upon the function played by the stimulus in each case.

The degree of control assumed by a stimulus over an operant behavior is a function of the differential consequences which follow that behavior. For example, motorists stop every time they are confronted with a red traffic light yet the sign of an overcast sky does not compel pedestrians to carry an umbrella. The relationship between a cloud formation and rain has not been as strongly established as the relationship between passing through a red light and a traffic accident.

Procedures Employing the Technology of Stimulus Control

"Cueing" procedures in which discriminative stimuli are arranged to exert considerable control over a desired behavior have been used as a teaching device for centuries. Once a target behavior has been established, then supporting cues can be gradually withdrawn to allow the behavior to be influenced by naturally occurring events. "Prompting"

is a variation of the cueing procedure in which verbal instructions serve as stimuli to produce approximations to a target behavior. Hopkins (1968) illustrated a case where candy failed, as a consequential device, to increase the frequency of a child's smiling behavior. Smiling occurred too infrequently for any relationship to be established between the target behavior and its consequence, candy. Verbal prompting provided the discriminative stimulus for smiling to occur at a sufficiently high rate so that candy could act as a positive reinforcer.

Another procedure which involves the acquisition of new behaviors through stimulus control has been referred to as modeling. Bandura (1969, p. 118) states that one can acquire "intricate response patterns merely by observing the performance of appropriate models". Bandura has named three types of behavior that can arise from the observation of a model.

1. An individual may acquire new responses not previously part of his repertoire (Modeling effect).

2. The consequences of a model's actions may have an "inhibiting effect" on similar observer behaviors. Whereas the incidence of imitation of positively reinforced outcomes is likely to be higher (disinhibitory effect). For example a child is likely to call out answers in class if he has seen other pupils rewarded for calling out. On the other hand the reverse will be true if he has witnessed a classmate punished for that behavior.

3. Finally a "response facilitation effect" operates when a model's behavior serves as a cue to facilitate previously acquired responses.

The modeling technique may be used separately or in conjunction with other methods. For example, Lovaas, Freitag, Nelson, & Whalen (1967)

successfully used a combination of modeling and shaping procedures in a training program with schizophrenic children.

Component II: Contingency Management

Although antecedent events can strongly influence the probability of instrumental behavior, their effect upon the recurrence of that behavior is subordinate to the effect of consequent events. The process of arranging appropriate consequences to ensure that a desired behavior will reoccur has been referred to by Homme et al., (1968) as "contingency management". Contingency management pertains to the third component of the operant conditioning model, the reinforcing consequence of responses. Because both operant conditioning and contingency management aim to strengthen desired behaviors, both processes employ consequences which increase the frequency of behavior. Such consequences are referred to as reinforcers and they may be categorized as either positive or negative depending upon the effect that their presentation or withdrawal has upon the production of the behavior in question.

Positive reinforcers are regarded as pleasant stimuli, and therefore their presentation serves to increase the behavior which they follow. Negative reinforcers on the other hand are aversive in nature, and consequently behaviors, such as withdrawal, which result in the termination of the unpleasant event will be strengthened. Although both reinforcers serve to increase behavior, the effect of a positive reinforcer is produced by its presentation, whereas the effect of a negative reinforcer is produced by its withdrawal.

It is fallacious to assume that one event will serve as a reinforcer for all individuals at all times. Bandura (1969, p. 222) emphasized that reinforcement is a "relational rather than an absolute property" of an event. While it is generally assumed that praise and social approval are universal positive reinforcers, Levine and Simmons (1962) showed that social attention functioned as an aversive stimulus for a group of emotionally disturbed delinquents. Hall, et al., (1968) reported also that abundant social contact and approval did not serve as positive reinforcement when used in a non-contingent manner. The reinforcing value of an event is also effected by momentary states of deprivation of an organism. For example, repeated presentation of food and other primary reinforcers can lead to a state of satiation during which the reinforcing value of the reward is temporarily diminished.

	Stimulus presented	Stimulus removed	Stimulus withheld
Pleasant stimulus	Positive Reinforcement	Omission	Extinction
Noxious stimulus	Punishment	Negative reinforcement	

Figure 2. Five Basic Kinds of Instrumental Conditioning,Classified by the Consequences of an Act. (Adapted from Rachlin, 1970.)

Procedures Employing Contingency Management to Develop Behavior

The most effective consequential method of establishing a behavior is by providing positive reinforcement whenever the behavior occurs. Once the response in question has been established, it is no longer necessary nor economical to use continuous reinforcement to maintain it. Lindsley (1964, p. 65) identifies the tendency of students to confuse the "acquisition of behavior with its maintenance". Behavior can be effectively maintained by intermittent reinforcement according to a number of different schedules (Ferster & Skinner, 1957). These schedules are specified in terms of the passage of time (interval schedule) and/or the number of responses emitted (ratio schedule).

Behaviors acquired through the application of stimulus control techniques such as prompting or modeling can be strengthened by the systematic application of a consequential procedure commonly known as shaping. This process involves the positive reinforcement of approximations to a desired behavior. Wolf, et al., (1964) employed both modeling and shaping procedures concomitantly in order to develop adaptive behaviors of an autistic child. Food was initially used to reinforce approximations to the modeled behavior, however it was later replaced by less contrived rewards such as social outings. Shaping also plays a decisive role in the development of young childrens' speech. Infants are initially capable of making all the vocal sounds produced by adults who speak different languages. Osgood (1953) suggests that infants are at first reinforced for making approximations to meaningful words. Improved performance is later shaped by the

differential reinforcement of significant others.

Procedures Employing Contingency Management to Eliminate Undesirable Behavior

Although punishment, omission, and extinction are different procedures, the terms are often used synonymously because they share the common effect of decreasing the frequency of behavior.

Punishment. Punishment is brought about when a negative reinforcer is made contingent upon the production of an undesirable behavior. The use of punishing procedures is seldom recommended because of the adverse reactions which can result. Responses which coincide with the termination of the aversive event can be intermittently reinforced and result in behavior, such as aggressive action, which will prove resistant to change.

According to the principles of learning theory, teachers and other environmental stimuli associated with the punishing event, run the risk of becoming conditioned aversive agents. Such an association would serve to decrease the positive reinforcing value of teachers as behavioral change agents. Avoidance behaviors such as tuning out or truancy are frequently the product of classrooms where aversive stimuli abound.

Omission. When the production of an undesirable behavior brings about the removal of a positive reinforcer, the effect is akin to that of punishment. In using the omission procedure to reduce thumb sucking behavior, Baer (1962), made the termination of an

enjoyable cartoon contingent upon thumb sucking. A further variation of this omission procedure is a response cost program in which points are subtracted for undesirable behavior. Such a technique was effectively used by Broden et al., (1970) to reduce the disruptive behavior of junior high school students. Hall et al., (1970) reported a parent-operated study in which the spectacular increases in time spent on homework and music practices were attributed to the use of a negative point system. The essential difference in the application of aversive consequences (punishment), and the withdrawal of pleasurable consequences (omission), is that omission procedures do not generate the disruptive emotional characteristics associated with punishment procedures.

Time out. The "time out" technique is a variation of the omission procedure in which an offender is placed in a situation void of any extrinsic reinforcement. Broden et al., (1970) reported that this social exclusion strategy proved to be the only effective method of bringing about a desirable change in the disruptive behavior of a violent junior high student. The time out procedure is most effective when an offender is removed in a firm but non-hostile manner from the scene of reinforcement. The offender's removal should be carried out with minimal social and verbal interaction to avoid the positive reinforcement of oppositional behavior by peer attention. Wolf, et al., (1964) reported the success of extinction and time out procedures in eliminating the violent temper tantrums of a young child who had not previously responded to physical restraint or sedation.

Social exclusion also proved more effective than verbal reprimands in reducing the amount of aggressive behavior which occurred during delinquent boys' gym period (Tyler & Brown, 1968). Once the time out procedure was discontinued, the quarreling reappeared. This indicates that although the time out procedure is an extremely effective method of control, its effects are not enduring. Wahler (1969), reported the use of the time out technique by parents. The parents were instructed to exclude their child from the room whenever he engaged in oppositional behavior, yet to positively reinforce cooperative behaviors each time they were exhibited. The child's affective reaction to his parents after these time out experiences, indicated that the reinforcing value of the parents increased as a result of such actions. Thomas, Becker & Armstrong (1968) reported another effective time out procedure in which the teacher would turn out the lights, turn her back on the class and wait for silence before she proceeded with the lesson.

Extinction. Because omission and extinction procedures share the common effect of decreasing behavior they are frequently confused. However, the subtle difference between the two lies in their management of positive reinforcers. Omission procedures _withdraw_ positive reinforcers, while extinction procedures _withhold_ a specific positive reinforcer.

Extinction occurs when the contingency relationship between a behavior and its maintaining consequence is disrupted due to the absence of the particular reinforcing event. According to operant

theory, if this relationship is severed, the behavior will then be extinguished from the organism's behavioral repertoire. Two distinctive effects associated with the extinction process have been reported in research literature. During the early stages of its operation, there is a marked increase in the frequency of the behavior being extinguished. Accompanying this, there is the appearance of emotional behaviors called "frustration" behaviors.

The appearance of these effects is related to the schedule of reinforcement of the maintaining event and the behavioral repertoire of the individual. Although the period of time involved in the extinction of a behavior that has been maintained by intermittent reinforcement is more extensive than for one that has been continuously reinforced, there is less likelihood of the appearance of emotional behaviors during this extinction process.

In classroom situations, extinction of an undesirable behavior such as calling out should be carried out in combination with the positive reinforcement of an incompatible behavior such as hand raising. Hart, Allen, Buell, Harris, & Wolf (1964) successfully extinguished operant crying by withholding attention to the crying and correspondingly giving attention to the child's self-help responses in frustrating situations. A reversal procedure reinstated the frequency of the crying to its baseline level.

Summary

The Operant Conditioning model employed to change behavior in the laboratory, has provided the basic principles for behavior

modification procedures in the natural environment. Intervention techniques can be classified as procedures of stimulus control or contingency management. Reports in the literature indicate that antecedent control procedures such as cueing, prompting and modeling play an important role in the development of adaptive behaviors. However, contingency management procedures to date have been most extensively used. Of the different consequential techniques reviewed, positive reinforcement procedures appear to be most applicable to educational settings.

III. REVIEW OF APPLIED EXTRINSIC REINFORCEMENT IN THE CLASSROOM

Contingent Versus Non-Contingent Positive Reinforcement

An expanding body of empirical evidence is working to refute the popular misconception that indiscriminate attention is sufficient to foster the development of desirable behavior and academic skills. Hart et al., (1968) demonstrated conclusively that non-contingent attention, whether continuously or intermittently awarded, failed to develop cooperative behaviors of a pre-school isolate. It was not until social attention was made contingent upon target behavior that an appreciable change took place. During a reversal condition, abundant non-contingent attention failed to maintain the cooperative behavior developed during the contingent phase. Therefore, it could be concluded that the development of social skills was less a function of the amount of teacher attention than it was of the nature of that attention.

The necessity for a contingent relationship between behavior and reward was also effectively demonstrated by O'Leary et al., (1969). Children in this study showed total disregard for rules which held no consequences for them. The implementation of contingent token reinforcement reduced class disruptive behavior drastically. Bushell, et al., (1968) report a reinforcement program in which the level of study behavior of pre-school children was increased by the contingent use of tokens. Once tokens were stripped of their value and access to "special events" was therefore assured for all pupils, study behavior declined rapidly.

The value of contingent reinforcement was further demonstrated in a report by Hall et al., (1970) in which tardy pupils were rewarded for prompt arrival at class by having their names placed on a class patriot chart. A marked decrease in punctuality was evident once this contingency arrangement was discarded.

Extrinsic Positive Reinforcers

The term "extrinsic reinforcer" encompasses any reinforcer available in the external environment. Perhaps the most basic form of extrinsic reinforcer is a primary reward such as food which "does not depend upon previous conditioning for its reinforcing power" (Hall, 1971, p. 4).

O'Leary & Drabman (1971) cite historical accounts of teachers who used tangible reinforcers to reward learning. Examples included the use of honey and nuts in the 12th Century; the use of food instead of the cane (Erasmus); and later the use of stars, medals and prizes to

motivate learners.

Primary reinforcers, however, are subject to a satiation effect which causes their rewarding value to rapidly diminish. Ayllon & Haughton (1962) used food as a primary reward to reinforce mealtime punctuality at a mental institution. A state of deprivation was maintained to increase the reinforcing value of the food thereby making it a very powerful means of controlling behavior.

In cases where social attention has not acquired reinforcing effects, primary reinforcers have to be initially used to modify behavior. Wolf et al., (1964) reported the use of candy and fruit to initiate a program with an autistic youngster. Even primary reinforcers may not be effective in developing a behavior which occurs at a very low frequency. Hopkins (1968) was forced to use verbal prompting initially to establish smiling at a rate sufficient to be maintained by primary reinforcers.

Token Reinforcement Studies

Reports of the use of Token Reinforcement programs in the literature have accelerated over the past decade. Perhaps the highly successful outcomes of such ventures could account for their increasing popularity.

As a result of continuous association with primary or secondary reinforcers, a neutral stimulus (such as a piece of green paper) can acquire the ability to function as a generalized reinforcer (such as a dollar). Tokens have been used in this capacity with children for whom social stimuli have little reinforcing value. The advantages of tokens

over other extrinsic rewards will be discussed later in this chapter. Considerable variation exists in the nature of tokens and back up reinforcers used so far in token reinforcement programs. For example: check marks, redeemable for candy and toys (Birnbrauer et al., 1965); plastic freezer chips for items from a school store (Hill, 1970); negative token points which resulted in loss of privileges (Barish et al., 1969); group points exchanged for privileges such as increased gym time, or short breaks from work (Schmidt, & Ulrich, 1969).

The effectiveness of the most highly qualified teacher is diminished in an environment which is not conducive to learning. Token reinforcement programs were instituted initially to control disruptive classroom behavior so that the learning situation could be enhanced. Specific behaviors such as cursing the teacher, chasing peers around the room, throwing objects, and refusing to obey the teacher, have been reported as interfering behaviors which impede learning in a classroom setting. O'Leary et al., (1969) reported that conditions such as a structured academic program, a knowledge of class rules, and contingent teacher attention failed to reduce the high rate of disruptive behavior which occurred in a grade two class. In two separate phases, contingent use of tokens proved effective in reducing this undesirable behavior so that the classroom environment was conducive to work.

Tokens have been used in place of other tangible rewards because they are more easily dispensed and their presence is usually less distracting in a classroom situation. Perhaps the overriding advantage of using these generalized reinforcers is that it is not necessary to know

specific reinforcers for each individual. In addition, a wide variety of back up reinforcers can maintain behavior at a desirable level without risk of satiation. Students of limited ability can be spared the confusion of lengthy explanations of the mechanics of token programs by simply demonstrating the contingencies that operate.

Token reinforcement programs do not always produce the results which are anticipated. Karraker (1971) lists examples of programs which were ineffective because of the following reasons:

> too many target behaviors were subject to modification at one time; back up reinforcers were determined by class vote rather than individual choice; tokens lost their value because back up rewards were not changed or limited in number.

Kuypers, Becker & O'Leary (1968) reported a token system which failed because the teacher concerned had insufficient background knowledge of the principles of behavior theory. The authors emphasized the need for teachers involved in such programs to consult with qualified resource personnel.

To be optimumly effective,tokens should be easily dispensed and should become the individual property of each child. Their value should be readily understood by all pupils and their consequences should ideally have some relevance to the education of the child for example the teaching of economic skills of exchange which function outside the classroom as well.

Individual differences and tokens. It should not be assumed from reference to group data that individual reactions to tokens are homogeneous. In a study to determine whether tokens were necessary to

maintain high levels of accuracy and study behavior of retarded children, Birnbrauer et al., (1965) found considerable variation in the reactions of these pupils to the withdrawal of tokens. Broden et al., (1970) also reported marked variation in the reactions of pupils under different experimental conditions. Three students initially refused to cooperate in the token reinforcement program. Two of these students became involved only after their verbal protests failed to elicit teacher attention. The defiant behavior of the third pupil deteriorated to the point where it was adversely affecting the working environment. A time-out procedure resulted in the removal of this pupil from the class and from the source of abundant peer reinforcement. It was not long before this pupil requested to be included in the token program.

Group resistance was expressed by institutionalized girls who threatened to withdraw from an afternoon token program unless their demands for a morning token system were met (Meichenbaum, et al., 1968).

Shores (1969) conducted a three-way factorial study on social class, academic achievement and reinforcement conditions. He found social class to be a distinguishing factor when the performance of learning disabled children, on tasks involving tangible reinforcement, were compared. The performance of lower class children decreased most unexpectedly when tangible reinforcement was made available. It was hypothesized that the impact of the concrete rewards served to reinforce guessing.

The application of token reinforcement has been extended to

academic behavior as well as social behavior. Kortas (1970) using a token reversal procedure found that token reinforcement was responsible for a decrease in deviant behavior and a corresponding increase in attending behaviors. In addition to this, the percentage of programmed reading frames correctly answered was significantly higher during both token phases. A most unexpected result of the experiment was that the number of items completed decreased during each token period.

Similar results were reported by Hill (1970) attesting the value of token reinforcement programs in developing desirable classroom behavior and facilitating academic performance of retarded pupils. Demonstrative evidence of the effectiveness of tokens in increasing academic behaviour of underachievers was also reported by Wolf, Giles & Hall (1968). The experimental token class increased 1.5 years compared with the control group's .8 years on a Stanford Achievement Test.

The most extensive study of token reinforcement systems has been reported by Hewett et al., (1969). The Santa Monica Project was carried out with six classes of emotionally disturbed children. Improvement in arithmetic and task attention was greater for those in the class where the token system was operating,over those in the control class. Class C.E. was subject to control conditions for the first half year until tokens were instituted. Arithmetic and task attention increased significantly once tokens were in operation. Group E.C. who worked under token condition for the first half year before tokens were

discontinued, showed an unexpected increase in task performance. This is one study which demonstrates that students do not become dependent or "hooked" on tokens.

Social Reinforcement Studies

Reinforcers range in order of complexity from most primitive primary rewards (water) through conditioned and generalized reinforcers (money) to intrinsically governed reinforcers (pride in a job well done). A goal in our socialization process is to develop social events such as agreement, praise, encouragement and gestures of approval, so that they act as conditioned reinforcers.

Increasing evidence suggests that social reinforcement can be responsible for maintaining deviant as well as desirable behavior. In many cases, the undesirable behavior is inadvertently reinforced by frequent and contingent social attention. Hart et al., (1964) found that extremely high rates of crying were being maintained by parental attention. Once such attending behaviors were withdrawn, operant crying was completely eliminated. Williams (1959) reports that temper tantrums and crying spells which were being unintentionally reinforced by parents, disappeared once the parents had been instructed to ignore such behavior.

Further evidence of contingent social attention maintaining undesirable behavior has been reported by Zimmerman & Zimmerman (1962). In this case a child's sub-standard academic performance in spelling succeeded in gaining him inordinate amounts of help and attention. This failed to effect any increase in his spelling performance.

However, once time limits were imposed and teacher attention was made contingent on correct responses, a considerable improvement resulted.

It can be seen that withdrawal of social attention will undoubtedly serve to extinguish classes of undesirable behavior. However, for maximum effectiveness, social reinforcement should be made contingent upon opposite or incompatible modes of behavior. In this way the likelihood of equally disruptive attention-getting behaviors will be minimized.

Contingent use of social attention has proven most effective in helping individuals acquire more desirable behaviors. For example, Hart, Reynolds, Baer & Brawley (1968) reported the development of the cooperative behavior of an isolate child using contingent attention. Harris, Johnston, Kelley & Wolf (1964) also used social reinforcement to develop regressed motor skills of a pre-schooler.

The effect of adult attention has also been systematically studied in group settings such as classrooms. Hall et al., (1968) employed a reversal procedure with a small number of highly disruptive primary school pupils and found that teacher attention to study behavior did in fact increase that behavior. Supportive evidence was presented by Madsen et al., (1968) who found that disruptive behavior was not reduced when it was ignored, nor was it effected by the imposition of rules. Praising incompatible behavior was the only effective means of reducing disruptive outbursts.

The importance of the teacher's role in eliminating disruptive behavior as well as maintaining pro-social behavior was further

illustrated by Thomas, et al., (1968). This study was rather novel because it was carried out with a class of well-behaved middle class pupils. Once teacher approval was withdrawn, the frequency of verbalizations, gross motor and orientating behaviors almost trebled. Behavior such as aggression which was not peer reinforced, remained uneffected by the absence of positive attention. During the period when the teacher increased her rates of disapproving responses, disruptive behavior soared from 8% to 40%. Verbalizations and gross motor behavior were depressed perhaps because of the fear of reprimand. Perhaps the most pertinent lesson to be learned from the study is that teachers must share the responsibility for disruptive classroom behavior.

The potency of peer influence as an alternate source of reinforcement to teacher approval was clearly demonstrated in the study above. Oppositional behavior of the student who refused to take part in Broden et al's, (1970) token program was also maintained by peer attention. Birnbrauer et al., (1965) reported that the use of tokens served to minimize the effect of peer reinforcement on disruptive behavior. Evans & Oswalt (1968) proved that peer reinforcement techniques were successful in bringing about improved test performance of low achieving pupils. These pupils could earn extra recess time for the class by answering test questions correctly.

The basic assumption underlying the use of social reinforcement is that praise and commendation are important to children. Whelan & Haring (1965) found social reinforcement to be inadequate with a group of adolescents who had experienced a history of school and interpersonal

failure. Hall, et al., (1970) reported that verbal praise was insufficient to increase student performances on french quizes Levine and Simmons (1962) reported that social reinforcement even acted as an aversive consequence with a group of emotionally disturbed children.

Studies Comparing Social and Token Reinforcement

In a systematic replication of an earlier study, O'Leary et al., (1969) conducted an investigation into the effects of rules, educational structure, praise of appropriate behavior while ignoring its opposite(social reinforcement) and tokens on disruptive behavior of grade two children. The social reinforcement in this study remained in effect during token I, token withdrawal and token reinstatement phases of the experiment. Rules, educational structure and social reinforcers had no consistent effect on disruptive behavior. Although social reinforcement reduced disruptive behavior below baseline level for three pupils, its effect was the reverse with two boys whose behavior became so disruptive that this experimental period had to be shortened. Disruptive behavior was significantly reduced by the introduction of a token system. However, social reinforcement alone would not maintain this effect. Related academic gain of 1.5 years on C.A.T. would be attributed to the effectiveness of the token program.

A similar comparison of the effectiveness of social and token reinforcement on study behavior was carried out in a Junior High special class by Broden et al., (1970). When teacher praise became contingent upon study behavior, there was a noticeable increase from 29% to 57%. During the next phase, tokens which could earn early

dismissal from class, were awarded on a random interval schedule. Tokens plus social reinforcement increased study behavior to 74%. Study behavior regressed drastically to 18% when teacher attention was focused on non-study behaviors.

Birnbrauer et al., (1965) also found that social reinforcement alone was insufficient to change poor academic and classroom behavior. However, the authors suggest that social reinforcement could have been responsible for the maintenance of high study rates of five pupils once the tokens had been withdrawn.

Summary

A growing body of empirical research attests the valuable contribution already made by the application of contingency management in the classroom. Extrinsic reinforcers, such as primary rewards, tokens and social approval, which were initially applied to solve behavioral problems in special educational settings, are now being employed to develop a variety of adaptive behaviors in both normal and special classrooms. Although the comparative effects of different components of reinforcement programs require further evaluation, the place of positive reinforcement as a necessary component in educational settings has been affirmed.

IV. ANALYTIC PARADIGMS USED IN APPLIED BEHAVIORAL RESEARCH

Before any degree of confidence can be placed in the results of applied behavioral studies, the reliability of the experimental procedure used, must be effectively demonstrated. The two research designs principally used to demonstrate this reliability are the reversal and multiple baseline designs.

The Reversal ABA Design

To date the reversal experimental design has been the most frequently used technique for assessing the effectiveness of reinforcement conditions in classroom studies. As the name implies, behavior is observed before the introduction of an experimental condition (A), while that conditions remains in effect (B), and during a reversal period when the condition is withdrawn (A). Some studies have reinstated the experimental condition after A, thereby making an A.B.A.B. variation. Birnbrauer et al., (1965) reported an A.B.A.B. design in which the experimental variable was present during A, and withdrawn during B. If the rate of occurrence of the behavior during the experimental phase (B) is significantly different from it s rate during baseline and reversal phases (A), then a direct relationship between the experimental condition and the frequency of the behavior under study, is assumed.

An inherent problem in using reversal designs in classroom research is the reluctance of teachers to surrender satisfactory levels of behavior in order that baseline performance may be reinstated.

Studies by O'Leary et al.,(1967) employing tokens, and Becker et al., (1967) using praise, purposely did not include a return to baseline procedure for this reason.

An additional problem associated with the use of the A.B.A. design is the possibility that the behavior under study will not return to baseline level once the experimental condition is withdrawn. During the course of the experimental procedure the behavior may come under the control of other reinforcers in the environment. For example Paterson et al., (1965) found that the attending behavior of a hyperactive child failed to return to baseline during a reversal condition because the improvement in behavior was being maintained by peer reinforcement in the classroom.

If researchers use extrinsic reinforcement as a means to an end in developing more adaptive behavior, then surely their purpose will be defeated if target behaviors are expected to be so contingency-dependent that they will revert to pre-existing rates the moment contrived reinforcers are removed. The practical limitation of having to undermine experimentally induced gains renders the use of the reversal design in classroom research questionable.

The Multiple Baseline Design

An alternate research strategy to the popular reversal procedure was suggested by Baer, Wolf & Risley (1968). The multiple baseline design involves the measurement of a number of different behaviors concurrently over time. Once baseline measures have been obtained on each variable, the experimental condition is applied to

the first behavior. A change in the frequency of this behavior is then compared with its level predicted from the baseline observation. If the rates of the other variables remain relatively stable, and if it can be assumed that other uncontrolled variables would have similarly affected each of the other behaviors, then a causal relationship between the experimental condition and the change in the dependent variable can be implied.

Although the multiple baseline strategy is only a recent innovation, already several variations of the basic paradigm have been reported. Hall et al., (1970) reported an "across situation" variation in which the same behavior of a group of individuals was measured in three different situations. A drastic reduction in the undesirable behavior in each case was evident at that point in time which corresponded to the introduction of the intervention procedure.

Risley & Hart (1968) employed a further variation of the multiple baseline design to study language development of poverty-area preschoolers. The authors investigated the effect of one experimental procedure as it was sequentially applied to several behaviors of the same individuals. They found that there was a significant change in each of the three behaviors being studied, at the point where the experimental contingency was applied.

Hall et al., (1970) reported a third variation in which behavioral change was measured "across individuals". In this study three failing students were required to remain after school for tutorial sessions. The performance of each pupil increased significantly at

that point in time which corresponded to his first tutorial session.

In conclusion the multiple baseline design has enabled researchers to study the on-going effects of a variety of experimental variables upon different behaviors, different individuals and in different situations. Because of its utility and economy the multiple baseline strategy appears to lend itself ideally to behavioral research in the classroom.

V. HYPOTHESES

The efficacy of employing contingent reinforcement procedures to facilitate learning has been demonstrated with reference to reducing disruptive behavior (O'Leary & Becker, 1967; Madsen, et al., 1968; Barish, et al., 1969); increasing task orientated behavior (McKenzie, Clark, Wolf, Kothera & Benson, 1968; Broden, et al., 1969); boosting academic output (Birnbrauer, et al., 1965; Tyler & Brown, 1968; Nolen, et al., 1967; Kortas, 1970).

The overall purpose of this study is to investigate the effect of different extrinsic reinforcement conditions upon three classes of student behavior, namely on-task behavior, productivity, and academic accuracy.

Hypothesis I

Extrinsic reinforcement procedures have a significant effect upon:

1(a) students' on-task behavior;

1(b) students' academic productivity;

1(c) students' academic accuracy.

If Skinner's view of teaching as "the arrangement of contingencies of reinforcement which expediate learning" (Skinner, 1969, p. 15) is correct, then the systematic application of any form of contingent reinforcement should increase the efficiency of the teaching process. The second set of hypotheses are concerned with the value of using planned reinforcing consequences, as opposed to employing rewards which are non-contingently applied.

Hypothesis 2

Contingent token + social reinforcement is superior to non-contingent token reinforcement in increasing rates of:

2(a) on-task behavior;

2(b) academic productivity;

2(c) academic accuracy.

Hypothesis 3

Contingent social reinforcement alone is superior to non-contingent token reinforcement in increasing rates of:

3(a) on-task behavior;

3(b) academic productivity;

3(c) academic accuracy.

Most teachers, whether they are fully aware of it or not, employ contingent reinforcement whenever they acknowledge desirable behavior with praise or privileges. This haphazard, yet contingent use of reinforcement characteristic of the majority of classrooms, should have a different effect to a directionless non-contingent strategy where rewards exist independent of actions.

Hypothesis 4

Sporadic use of contingent reinforcement, characteristic of baseline, is superior to the use of non-contingent token reinforcement in maintaining:

4(a) on-task behavior;

4(b) academic productivity;

4(c) academic accuracy.

Although token reinforcement programs employing token + social reinforcement have been reported to have beneficial effects in decreasing disruptive behavior (O'Leary & Becker, 1967; Barish, et al., 1969; Madsen et al., 1968); increasing study behavior (Broden et al., 1969; McKenzie et al., 1968; Hewett, et al.,1969); and boosting academic accuracy (Nolen et al., 1967; Kortas, 1970; Birnbrauer et al., 1965), no attempt has been made to systematically study the way in which the two components, social reinforcement and token reinforcement alone, effect dependent classroom behaviors. Presumably the effect of the combined strategy of social + token reinforcement will be superior to each of the individual components However the degree to which this difference exists, awaits evaluation. The following set of hypotheses have been developed to: (a) evaluate the effectiveness of contingent reinforcement procedures over those sporadically applied, and (b) to compare the difference between single and composite reinforcement strategies.

Hypothesis 5

Contingent social + token reinforcement is superior to the sporadic positive reinforcement characteristic of the baseline condition, in effecting an increase in:

5(a) on-task behavior;
5(b) academic productivity;
5(c) academic accuracy.

Hypothesis 6

Contingent social reinforcement is superior to the sporadic positive reinforcement, characteristic of the baseline condition, in effecting an increase in:

6(a) on-task behavior;

6(b) academic productivity;

6(c) academic accuracy.

Hypothesis 7

Contingent token reinforcement is superior to the sporadic positive reinforcement, characteristic of the baseline condition, in effecting an increase in:

7(a) on-task behavior;

7(b) academic productivity;

7(c) academic accuracy.

Hypothesis 8

Contingent social + token reinforcement is superior to contingent social reinforcement alone in maintaining higher rates of:

8(a) on-task behavior;

8(b) academic productivity;

8(c) academic accuracy

Hypothesis 9

Contingent social + token reinforcement is superior to contingent token reinforcement alone in maintaining higher rates of:

9(a) on-task behavior;

9(b) academic productivity;

9(c) academic accuracy

CHAPTER III

METHODOLOGY

Subjects and Setting

The study investigating the effects of extrinsic reinforcement upon student classroom behavior was carried out with two classes at L. Y. Cairns Vocational School in Edmonton. L. Y. Cairns School caters to students "who have experienced difficulty in the academic courses of the elementary school and who would not benefit from the regular programs of the secondary schools".

Although the students of L. Y. Cairns school would be classified as mildly retarded (IQ 55-69) or of borderline intelligence (IQ 70-84) under the American Association on Mental Deficiency classification (Heber, 1961), scientific literature still makes reference to these pupils as educable mentally retarded (EMR). The majority of first year students attending L. Y. Cairns are graduates of junior opportunity classes within the Edmonton Public School system. Table I reports data pertinent to the chronological age and IQ for students in classes 1A and 1B. Ages were calculated as of October 1, 1971 and all intelligence levels quoted were the results of the Wechsler Intelligence Scale for Children test which was administered within one year prior to the students' enrolment at L. Y. Cairns school.

The experimental group was composed of one class of fifteen boys and another class of fourteen girls. Special administrative changes enabled both classes to receive math instruction from the same teacher. Although this math program emphasized the development of practical math skills such as measuring length, weight, time,

TABLE I

C.A. AND I.Q. DATA FOR EXPERIMENTAL GROUPS

	CLASS 1A		CLASS 1B	
	Chronological Age	I.Q.	Chronological Age	I.Q.
Mean	12.9	80	12.7	70
S.D.	4.7	7.5	2.0	6.7
Range	12.2-13.9	68-93	12.4-12.11	57-77

temperature and handling money, fifteen minutes of each lesson was reserved specifically for the drill and practice of basic numerical operations. Individual data, pertinent to each child's attending behavior, productivity and accuracy, were collected during this stable drill and practice session each day.

At the conclusion of the study, data on five of the original twenty-nine pupils were rejected because it failed to meet the criteria for analysis. Two students had moved out of the district mid-way through the project, two other pupils had been absent from class for more than 35% of the duration of the project, and the data of one advanced student were disqualified because this boy had been working on math assignments of a different nature to the rest of the experimental group.

Materials

Math Program

During the entire experimental period students worked on drill and practice assignments from an "Individualized Mathematics" kit developed by Suppes & Jerman. The kit is an adaptation of material used in the author's computer assisted instruction (C.A.I.) program at the Institute for Mathematical Studies in the Social Sciences, at Stanford University (Jerman, 1969).

Units one through ten, which dealt with basic addition and subtraction processes, were used in the project. Each unit is composed of a pretest, twenty-five individual assignments and a posttest. Students are initially required to complete the pretest. Their perform-

ance on this pretest determines the level of difficulty of their first assignment. Each of the five lessons in a unit is sub-divided into five assignments of increasing difficulty. This allows a superior student to progress through the five lessons at level E whereas a pupil experiencing difficulty would complete assignments at level A. (See Appendix A.)

Worksheets

Special assignment sheets, designed to facilitate clarity of work and ease in marking, were supplied to students at the beginning of each new math lesson. (See Appendix B.)

Date Stamp and Timing Device

At the end of each fifteen minute experimental period, students were instructed to put their pencils down and wait for the date stamp to be placed on their work sheets. The stamp was placed immediately after the last fully completed item. This precaution served to ensure the reliability of the productivity measure because the stamp marked the official end of one day's work.

Reliability of the time period scheduled for each lesson was ensured by the observer, who measured the fifteen minute period on the IBM wall clock, and the teacher who measured the same length of time on his wrist watch.

Tokens and Back-up Reinforcers

Rubber stamps representing 1¢, 5¢, 10¢ and 25¢ coins were used as tokens throughout the project. Money stamps were chosen in prefer-

ence to more traditional tokens, such as poker chips and stars, to enable students to gain meaningful experience with currency values. In addition, the laborious task of dispensing large numbersof single tokens was eliminated by using multiples of one cent denominations. The difficulty involved in distributing large numbers of tokens in a classroom was indicated by Hill (1970).

A number of highly motivating games served as back-up reinforcers. Students were allowed to select a certain game on the basis of their daily tally of tokens. Games such as "Pay the Cashier" were chosen to enhance small group interaction and fair play as well as to develop practical math skills such as counting money. Privileges such as keeping attendance records, and using the listening centre also served as back-up reinforcers. Valett(1960) found the use of privileges more desirable than primary reinforcers like candy, in a classroom situation.

Because the tokens employed in this study were to be awarded upon the number of items completed, the use of a "reinforcing event menu", (Homme et al., 1968, p. 427) where exchange rates between tokens and back-up reinforcers are prescribed, was considered unsuitable. Pre-established exchange rates in this case would ignore individual variation in work rate and would thereby penalize the slower student. By allowing the teacher the flexibility to subjectively decide exchange rates for each pupil, small but significant improvements of the slower pupils were recognized and rewarded.

Experimental Design

One advantage of the multiple baseline design discussed in chapter 2 was that it enables researchers to evaluate the effects of one experimental procedure upon several different behaviors concurrently. Because the purpose of this thesis was to investigate the effect of several experimental procedures upon three dependent variables, an extension of the "across behavior" multiple baseline strategy (Hall et al., 1970) was employed. The initial set of independent variables was made up of four different reinforcement conditions. However, because of a time limit imposed by the Christmas vacation, all these conditions could not be employed with each class. Therefore, it was decided that in order to facilitate a greater number of comparisons between the effect of separate reinforcement strategies, each class would work under a different sequence of experimental conditions. Figure 3 shows a diagrammatic representation of the sequence in which different experimental procedures were applied to dependent variables in both classrooms 1A and 1B.

Experimental Conditions Used

Class 1A	Class 1B
1. Baseline	1. Baseline
2. Non-contingent Token Reinforcement	2. Contingent Token Reinforcement
3. Contingent Social Reinforcement	3. Contingent Token + Social Reinforcement
4. Contingent Token + Social Reinforcement	

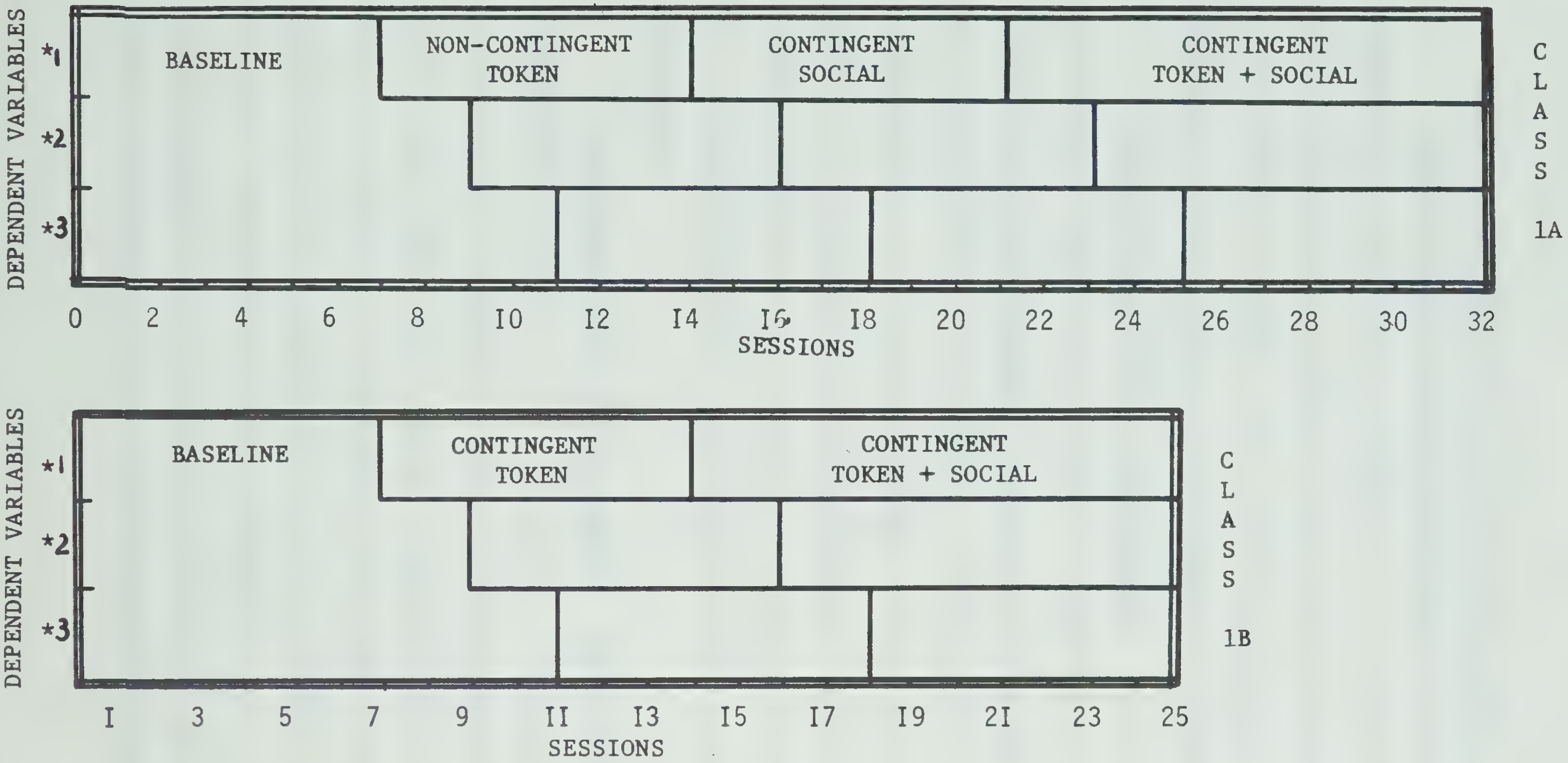

Figure 3. Outline of Experimental Procedures.

*Variable 1: On-task behavior
2: Productivity
3: Accuracy

Operational Definitions of Experimental Conditions

Baseline. The term baseline refers to the period of time immediately preceding the introduction of an experimental variable. During this period, the behavior under study is observed and recorded at it s natural frequency under conditions considered normal for that particular setting. Positive reinforcement is awarded sporadically.

Non-Contingent Token Reinforcement. During this period of time positive social reinforcement was intentionally withheld and token stamps were indiscriminately dispensed to all students regardless of the standard of their performance. No explanation of the rationale behind the use of the tokens was made. At the end of each 15 minute work period, students were freely allowed to select games of their choice from the material trolley. Even though rewarding consequences were employed during this experimental period, they were used non-contingently.

Contingent Social Reinforcement. Social reinforcement consists essentially of supplying those components of personal interaction which are perceived as rewarding. Words of encouragement such as "you were having some trouble with...but you seem to be doing much better now", words of praise such as "good work", "you have tried very hard","you managed to do more...today than you did yesterday", are verbal forms of social reinforcement for most students. Facial expressions and friendly gestures such as a pat on the back are further examples of social reinforcement. Social reinforcement was given when students

exhibited acceptable levels of on-task behavior, productivity and accuracy. Social reinforcement was the only extrinsic reward employed during the contingent social condition.

Contingent Token Reinforcement. The tokens and back-up reinforcers employed in this phase of the study were described earlier in the materials section of this chapter. During the contingent token period, token stamps were awarded according to a pre-arranged schedule, as consequences for student performance on each of the three dependent variables. Although a conscious effort was made by the teacher to suspend the use of social reinforcement during this phase of the project, special precautions were taken so that the classroom observer could signal the teacher in the event of inadvertent social reinforcement.

Contingent Token + Social Reinforcement. As the name suggests, reinforcement used during this phase of the study consisted of contingent token and contingent social reinforcement in combination.

Dependent Variables

On-task Behavior. On-task behavior was recorded as a ratio of the number of times that a student's behavior coincided with the operational definition of on-task behavior (see section on observer training) to the total number of observations made on that student. This ratio was then expressed as a percentage.

Productivity. The number of math examples fully completed during one fifteen minute experimental session was recorded as a

measure of a student's productivity on that particular day.

Accuracy. A measure of accuracy was determined by expressing the number of math examples correctly answered, as a percentage of the number fully completed during one experimental session.

Procedure

Seating Arrangements. Both classrooms were furnished with individual desks so that each student would have his/her own work space. Desks were arranged in rows so that students sat according to an alphabetical order. These seating arrangements remained unaltered throughout the duration of the project.

Five undergraduate students in special education attended the initial training session. Two other raters were trained at a later date. During the training session the group previewed the film, informally discussed the differences between on-task and off-task behavior and finally formulated the following operational definition.

Operational Definition of On-task Behavior. A pupil is on-task when:

- his(her) eyes are directly attending his(her) work assignment
- he(she) is attending visually to the teacher who is rendering assistance or giving instructions
- he(she) is involved in an activity deemed necessary for the completion of the work assignment, e.g. sharpening a broken pencil.

Observational Technique. The Time Sampling technique (Hall, 1971) was chosen in preference to event, duration, and interval recording procedures because it can produce a valid measure of a specific high frequency behavior over an extended period of time without requiring the split second precision of interval and duration recording nor the continuous observation required for event recording. This method can also accommodate unexpected interruptions, such as washroom breaks, without jeopardizing the data. The basic assumption underlying the time sampling procedure is that in a given situation, the behavior being observed at certain time intervals is representative of the behavior occurring during the total period.

Inter-rater Reliability. Hall's (1971) formula listed below, was used to determine a measure of correspondence between two observers.

$$\frac{\text{agreements}}{\text{agreements + disagreements}} \times 100 = \text{Percentage of Agreement}$$

Simply stated, the number of instances of agreement of the two observers on data sheets is divided by the possible number of occasions possible for agreement. This ratio is then expressed as a percentage of rater agreement. Table 2 shows the inter-rater reliability coefficients obtained during the first observer training session.

Table 3 shows the results of nine inter-rater reliability checks completed in class during the course of the study. Rater number six was the classroom teacher.

TABLE 2

INTER-RATER RELIABILITY COEFFICIENTS DURING INITIAL TRAINING SESSION

	Observers					
Observers	1	2	3	4	5	6
1	-	92	92	96	94	92
2		-	90	90	92	98
3			-	94	90	88
4				-	96	90
5					-	90
6						-

TABLE 3

INTER-RATER RELIABILITY COEFFICIENTS

OBTAINED DURING THE PROJECT

OBSERVER A		OBSERVER B	% AGREEMENT
1	vs	6	99
2	vs	6	96
3	vs	6	99
4	vs	6	93
5	vs	6	94
7	vs	6	94
8	vs	6	95
2	vs	3	95
8	vs	7	95

Familiarization with the Math Kit and Video Tape Recorder. The individualized math kit was introduced to both classes ten days prior to the commencement of baseline recording. This was done to enable students to become familiar with the mechanics of the program thereby avoiding mistakes which could be confounded with experimental treatments.

At the inception of the project it was proposed to record student task behavior on video tape to avoid the disruption of observers in the room, and to simplify the task of making rater-reliability checks. The V.T.R. was also introduced into the classroom early so that students could become accustomed to its presence. After viewing two trial tapes, it was apparent that the video camera with the addition of a wide-angle lens, was an unsuitable instrument for observing detailed behavior of fifteen individuals at one time. Low inter-rater reliability (60%) on the observation of these tapes confirmed this impression.

In view of this, alternate arrangements were made to train student teachers as classroom observers for the project.

Observer training. Because of the number of different observers involved, a training film of approximately ten minutes duration was produced at L. Y. Cairns School. This film showed one student engaging in a variety of different on-task and off-task behaviors, the most common of which are listed in Table 4.

TABLE 4

BEHAVIORS INCLUDED IN THE TRAINING FILM

Person	Example of Behavior
Student	working on an assignment card at his desk
Student	gazing out the window
Student	sharpening his pencil
Student	turning around to talk to a neighbour
Student	doodling on a scrap of paper
Student	discussing a problem with the teacher
Student	watching as teacher gives instructions to the class
Student	erasing an error
Student	receiving a new assignment card

Collection of Data

Observers made one behavioral rating approximately every five seconds. This meant that each student was observed at least ten times per session. The student's behavior at the time of observation was rated as either on-task or off-task, according to the operational definition described earlier. At the end of each session a percentage of on-task behavior was computed for each student.

The number of examples fully completed between one date stamp and the other was taken as a measure of the student's productivity that lesson. An accuracy measure was computed by the teacher and observer. They quickly marked individual assignments with the aid of answer keys, and recorded the number of items correct. This was converted to a percentage at the conclusion of the lesson.

An independent observer carried out weekly spot checks on productivity and accuracy measures to ensure that these measures were reliable.

Analysis of the Data

A continuous record of every student's performance on each of the three dependent variables was maintained throughout the project. After all the data had been collected, a short Fortran program was written to compute an individual's mean performance on each variable during the different experimental conditions. A single factor analysis of variance with repeated measures (Winer, 1962, p. 105-132) was then carried out on the treatment means for each variable to

determine whether the treatments used with each class were significantly different from one another.

When significant differences were found to exist, a Newman-Keuls (Winer, 1962, p. 85) a posteriori test was used to compare the differences between treatments. These comparisons were carried out at the .01 and the .05 level of significance.

CHAPTER 4

RESULTS

The data which were collected during the project were analyzed according to the parametric procedures outlined in the previous chapter. The results of these analyses will be reported in light of the hypotheses proposed in Chapter 2.

Hypothesis 1

Extrinsic reinforcement procedures have a significant effect upon:

1(a) students' on-task behavior;
1(b) students' academic productivity;
1(c) students' academic accuracy.

Results

The results of the one way analyses of variance indicate the following for each hypothesis:

1(a) An F ratio for conditions significant beyond the .01 level was obtained with both classes 1A and 1B for on-task behavior. This finding indicates that students' on-task behavior is significantly affected by extrinsic reinforcement procedures (see Tables 5 and 6).

1(b) An F ratio for conditions significant beyond the .01 level was obtained for both classes on productivity. This finding indicates that pupils' academic productivity

TABLE 5

SUMMARY OF THE ANALYSIS OF VARIANCE OF TREATMENT MEANS ACROSS ON-TASK BEHAVIOR. CLASS 1A

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	Obtained F-Value
Between subjects	2754.75	11	250.53	
Within subjects	7817.06	36	217.14	
Treatments	5813.50	3	1937.83	31.9174**
Error	2003.56	33	60.71	
Total	10571.81	47		

**p (.01) df = 3,33. F = 4.51

TABLE 6

SUMMARY OF THE ANALYSIS OF VARIANCE OF TREATMENT MEANS ACROSS ON-TASK BEHAVIOR. CLASS 1B

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	Obtained F-Value
Between subjects	819.69	11	74.52	
Within subjects	3207.06	24	133.63	
Treatments	2640.62	2	1320.31	51.2800**
Error	566.43	22	25.74	
Total	4026.75	35		

**p (.01) df = 3,33. F = 4.51

is also significantly affected by extrinsic reinforcement procedures (see Tables 7 and 8).

1(c) An F ratio on accuracy, for conditions significant at the .05 level for class 1A and non-significant for class 1B, suggests that academic accuracy was not affected by extrinsic reinforcement to the same extent as on-task behavior and productivity. Therefore hypothesis 1(c) could not be accepted without further replication (see Tables 9 and 10).

Graphic representations of students' on-task behavior, productivity, and accuracy during the experimental program are shown in figure 4 for class 1A and in figure 5 for class 1B. A visual comparison of these three different variables indicates that there is less variation in accuracy scores than there is in either on-task behavior or productivity scores. This indicates that academic accuracy was the variable least affected by the different experimental conditions.

In summary, the results of the analyses of variance, together with the graphic data depicted in figures 4 and 5 lend overwhelming support to hypotheses 1(a) and 1(b); however, hypothesis 1(c) was only partially supported.

Tables 5 and 6; 7 and 8; 9 and 10, show the results of the analyses of variance carried out for the on-task, productivity, and accuracy variables respectively in classes 1A and 1B. Due to the significant main effects, a Newman-Keuls a posteriori procedure was used to test the following hypotheses, $H_{2, 3, 4, 5, 6, 7, 8, 9}$. Six sets of comparisons were carried out at the .01 level of significance.

TABLE 7

SUMMARY OF THE ANALYSIS OF VARIANCE OF TREATMENT MEANS ACROSS PRODUCTIVITY. CLASS 1A

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	Obtained F-Value
Between subjects	2400.63	11	218.24	
Within subjects	2850.32	36	79.17	
Treatments	2331.96	3	777.32	49.4851**
Error	518.36	33	15.71	
Total	5250.96	47		

**p (.01) df = 3,33. F = 4.51

TABLE 8

SUMMARY OF THE ANALYSIS OF VARIANCE OF TREATMENT MEANS ACROSS PRODUCTIVITY. CLASS 1B

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	Obtained F-Value
Between subjects	2650.99	11	240.99	
Within subjects	2378.23	24	99.09	
Treatment	2109.39	2	1054.69	86.309**
Error	268.83	22	12.22	
Total	5029.22	35		

**p (.01) df = 2,22. F = 2.83

TABLE 9

SUMMARY OF THE ANALYSIS OF VARIANCE OF TREATMENT MEANS ACROSS ACCURACY. CLASS 1A

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	Obtained F-Value
Between subjects	4984.37	11	453.12	
Within subjects	2140.06	36	59.45	
Treatments	462.69	3	154.23	3.0342*
Error	1677.37	33	50.83	
Total	7124.44	47		

*p (.05) df = 3,33. F = 2.92

TABLE 10

SUMMARY OF THE ANALYSIS OF VARIANCE OF TREATMENT MEANS ACROSS ACCURACY. CLASS 1B

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	Obtained F-Value
Between subjects	2364.37	11	214.94	
Within subjects	1744.12	24	72.67	
Treatments	195.25	2	97.62	1.3867
Error	1548.87	22	70.40	
Total	4108.50	35		

*p (.05) df = 2,22. F = 2.07

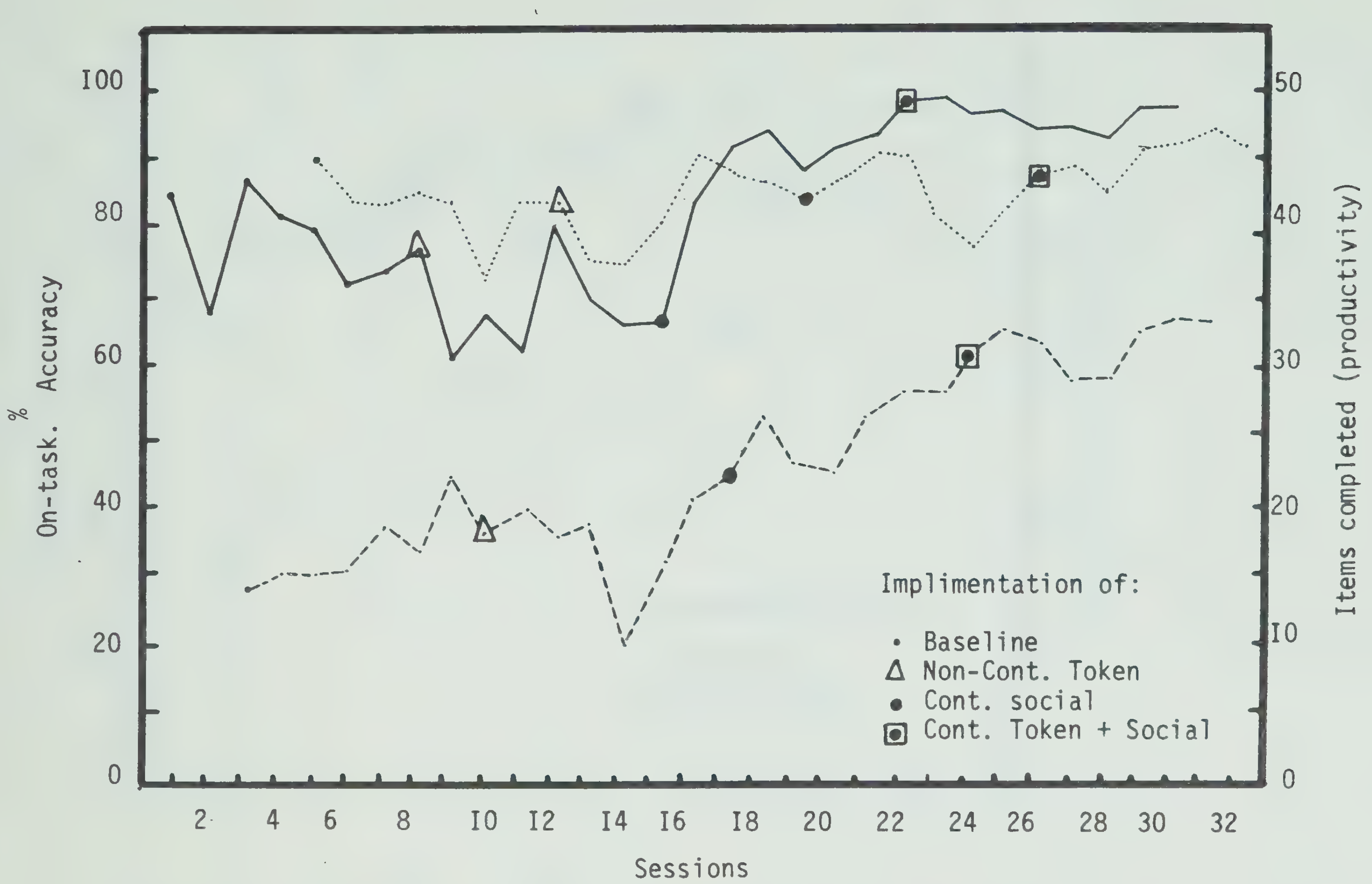

Figure 4. Daily record of IA students' on-task behavior (solid line), productivity (broken line), and accuracy (dotted line).

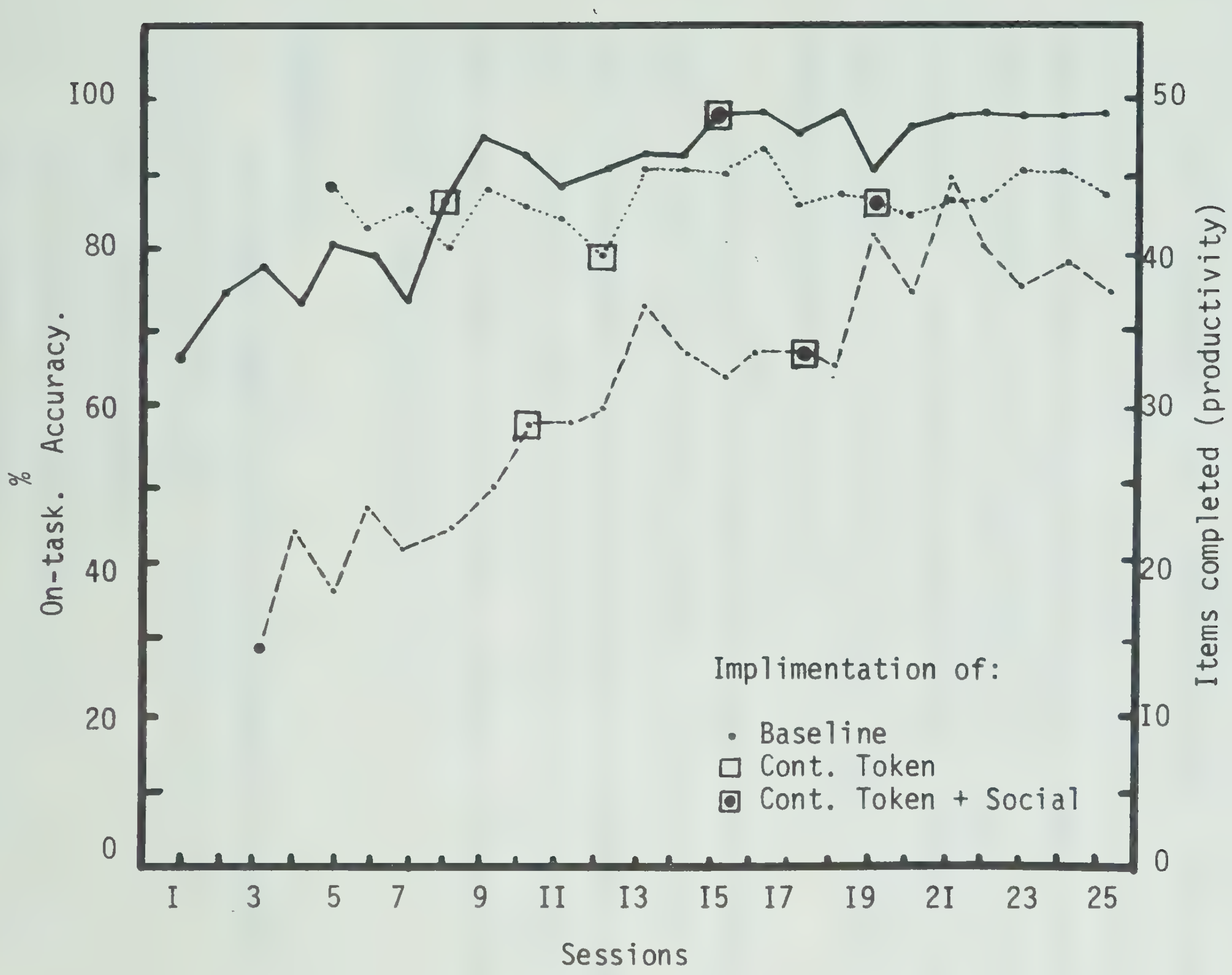

Figure 5. Daily record of IB students' on-task behavior (solid line), productivity (broken line), and accuracy (dotted line).

In cases where the means were not different at the .01 level, comparisons were carried out at the .05 level. Winer (1962, p. 84) suggests the following method for schematically summarizing the results of these comparisons.

$$\begin{array}{l} \underline{c\ e\ f\ a}\ b\ d\ g \\ \underline{} \end{array}$$

With reference to the illustration above, the treatments which are underlined by the same line do not differ from one another. However, treatments which are <u>not</u> underlined by a <u>common</u> line are different. Therefore, in the example above, treatments c, e, f, and a, do not produce significantly different effects from one another; however, the effects of treatments c, e, and f, are different from the effects of treatments b, d, and g.

The results of the Newman-Keuls comparisons shown in Tables 12 and 13 report experimental conditions as abbreviations. Table 11 lists the experimental conditions and the corresponding abbreviations used. In Tables 12 and 13 a double asterisk (**) represents a comparison at the .01 level of significance, whereas a single asterisk (*) represents a comparison at the .05 level.

Hypothesis 2

Contingent token + social reinforcement is superior to noncontingent token reinforcement in increasing rates of:

2(a) on-task behavior;

2(b) academic productivity;

2(c) academic accuracy.

TABLE 11

A SUMMARY OF ABBREVIATIONS USED FOR EXPERIMENTAL CONDITIONS

Abbreviation	Experimental Condition
B	Baseline Condition
N.C.T.	Non-Contingent Token Reinforcement
C.S.	Contingent Social Reinforcement
C.T.	Contingent Token Reinforcement
C.T. + S.	Contingent Token plus Social Reinforcement

TABLE 12

SUMMARY OF THE NEWMAN-KEULS COMPARISONS FOR EACH DEPENDENT VARIABLE. CLASS 1A

Dependent Variable	Result of the Comparison Between Ordered Means			
On-task behavior	N.C.T.,	b,	C.S.,	C.T.+ S.**
Productivity	b,	N.C.T.,	C.S.,	C.T.+ S.**
Accuracy	b,	N.C.T.,	C.S.,	C.T.+ S.*

TABLE 13

SUMMARY OF THE NEWMAN-KEULS COMPARISONS FOR EACH DEPENDENT VARIABLE. CLASS 1B

Dependent Variable	Result of the Comparison Between Ordered Means		
On-task behavior	b,	C.T.,	C.T.+ S.**
	b,	C.T.,	C.T.+ S.*
Productivity	b,	C.T.,	C.T.+ S.**
Accuracy	b,	C.T.,	C.T.+ S.

Results

The Newman-Keuls test for class 1A, conducted to compare the effects of contingent token + social reinforcement, and non-contingent token reinforcement upon (a) on-task behavior, (b) productivity, and (c) accuracy, revealed a significant difference beyond the .01 level for on-task behavior and productivity, and a significant difference at the .05 level for accuracy (see Table 12). Marked differences in students' performance under each condition add support to these results (see figure 4). In view of the data presented in Table 12, hypothesis 2 must be accepted in its entirety.

Hypothesis 3

Contingent social reinforcement alone is superior to non-contingent token reinforcement in increasing rates of:

3(a) on-task behavior;

3(b) academic productivity;

3(c) academic accuracy.

Results

The Newman-Keuls test for class 1A (see Table 12), conducted to compare the effects of contingent social reinforcement and non-contingent token reinforcement upon (a) on-task behavior, (b) productivity, and (c) accuracy, revealed a significant difference beyond the .01 level for on-task behavior and productivity. There was no significant difference in the effect of either condition on academic accuracy. Therefore, the data presented in Table 12, confirm part (a) and part (b) of hypothesis 3, but not part (c).

Hypothesis 4

Sporadic use of contingent reinforcement, characteristic of baseline, is superior to the use of non-contingent token reinforcement in maintaining:

4(a) on-task behavior;
4(b) academic productivity;
4(c) academic accuracy.

Results

The Newman-Keuls test revealed a significant difference at the .01 level between the effects of baseline reinforcement and non-contingent token reinforcement upon the on-task behavior of 1A students. Figure 4 shows on-task behavior plunging to its lowest level of the program, one day after the non-contingent condition was introduced. The two conditions did not show significant differences in their effects on (b) productivity and (c) accuracy. In view of the data presented in Table 12, part (a) of hypothesis 4 is accepted; however, parts (b) and (c) must be rejected as untenable.

Hypotheses 5, 6, and 7 are concerned with predicting the effectiveness of contingent reinforcement strategies in increasing levels of (a) on-task behavior, (b) productivity, and (c) academic accuracy, above baseline.

Hypothesis 5

Contingent social + token reinforcement is superior to the sporadic positive reinforcement, characteristic of the baseline condition, in effecting an increase in:

5(a) on-task behavior;
5(b) academic productivity;
5(c) academic accuracy.

Because both classes 1A and 1B worked under the conditions of baseline reinforcement and contingent token + social reinforcement, hypothesis 5 can be tested by making two identical comparisons.

Results

A Newman-Keuls test revealed a significant difference, at the .01 level, between the effects of contingent token + social reinforcement and baseline reinforcement, upon the (a) on-task behavior and (b) productivity of students in class 1A and 1B. A difference in the effect of these two experimental conditions upon academic accuracy was significant at .05 level for students in class 1A, and non-significant for students in class 1B. The data presented in Tables 12 and 13 confirm parts (a) and (b) of hypothesis 5; however, the prediction that contingent social + token reinforcement significantly increases baseline academic accuracy, cannot be accepted in full.

Hypothesis 6

Contingent social reinforcement is superior to the sporadic positive reinforcement, characteristic of the baseline condition, in effecting an increase in:

6(a) on-task behavior;
6(b) academic productivity;
6(c) academic accuracy.

Results

The results of the Newman-Keuls comparison between the effects of contingent social reinforcement and baseline reinforcement upon (a) on-task behavior, and (b) productivity(see table I2), indicate a significant difference beyond the .01 level in each case. Academic accuracy does not appear to be affected differently within either condition. Therefore the data in Table 12 indicate support for parts (a) and (b) of hypothesis 6, but not part (c).

Hypothesis 7

Contingent token reinforcement is superior to the sporadic positive reinforcement, characteristic of the baseline condition, in effecting an increase in:

7(a) on-task behavior;
7(b) academic productivity;
7(c) academic accuracy.

Results

A Newman-Keuls comparison revealed a significant difference (beyond the .01 level) between the effects of contingent token reinforcement, and baseline reinforcement for both (a) on-task behavior, and (b) productivity. Once more, academic accuracy was not affected differentially by either treatment. The data in Table 13 therefore supports sections (a) and (b) of hypothesis 7.

Hypotheses 8 and 9 are concerned with predicting the effectiveness of the combined strategy of token + social reinforcement over either of its single components, contingent token reinforcement or

contingent social reinforcement alone.

Hypothesis 8

Contingent social + token reinforcement is superior to contingent social reinforcement alone in maintaining higher rates of:

8(a) on-task behavior;
8(b) academic productivity;
8(c) academic accuracy.

Results

Table 12 shows the results of a Newman-Keuls comparison of the effects of contingent token + social reinforcement and contingent social reinforcement upon (a) on-task behavior, (b) productivity and (c) accuracy. A significant difference (beyond .01 level) was observed between the effects of the two conditions upon on-task behavior and productivity. Academic accuracy was not differentially affected by either condition. These results lead to the acceptance of only parts (a) and (b) of hypothesis 8.

Hypothesis 9

Contingent social + token reinforcement is superior to contingent token reinforcement alone in maintaining higher rates of:

9(a) on-task behavior;
9(b) academic productivity;
9(c) academic accuracy.

Results

The results of a Newman-Keuls comparison between the effects of contingent token + social reinforcement and contingent token reinforcement for class 1B (Table 13) upon (a) on-task behavior, (b) productivity and (c) academic accuracy, indicate a significant difference at the .05 level for on-task behavior, a significant difference at the .01 level for productivity and a non-significant difference for accuracy. These results lead to the confirmation of parts (a) and (b) of hypothesis 9.

SUMMARY OF GROUP RESULTS

The results of the different analyses carried out on the project data have been summarized briefly below:

1. On-task behavior and productivity were significantly affected by extrinsic reinforcement strategies. Academic accuracy did not appear to be influenced greatly during the short time the project was in operation.

2. Each contingent reinforcement procedure was superior to a non-contingent reinforcement strategy in producing higher rates of on-task behavior and productivity.

3. Contingent reinforcement employed sporadically during baseline, maintained higher levels of on-task behavior than were maintained by non-contingent reinforcement.

4. Each form of contingent positive reinforcement that was systematically applied, was more effective than the sporadic reinforcement used during baseline, in increasing on-task behavior and academic

productivity.

5. The combined strategy of contingent token + social reinforcement was superior to either of its components, contingent social or contingent token reinforcement, in effecting an increase in on-task behavior and productivity.

INDIVIDUAL REACTIONS TO DIFFERENT EXPERIMENTAL CONDITIONS

Although the purpose of the present study was to investigate the effects of different extrinsic reinforcement conditions upon the on-task behavior, productivity, and academic accuracy of two groups of students, considerable within-group variation became noticeable upon an inspection of individual performance profiles (see Appendices C, D, E, F). Individual profiles were classified on the basis of the comparative increases which were made during the different experimental conditions. Figures 6 and 7 show the categories which emerged in class 1A and class 1B respectively.

Category 1 (fig. 6) represents the performance of those students whose levels of on-task behavior and productivity remained relatively unaffected by any experimental condition. An exceptionally high rate of on-task behavior during baseline, may have resulted in a ceiling effect which served to inhibit further dramatic increases.

A more common reaction in class 1A is represented by Category 2 (fig. 6). In this case, a student's performance was increased significantly above baseline during the period in which contingent social reinforcement was in effect. Any subsequent increase in

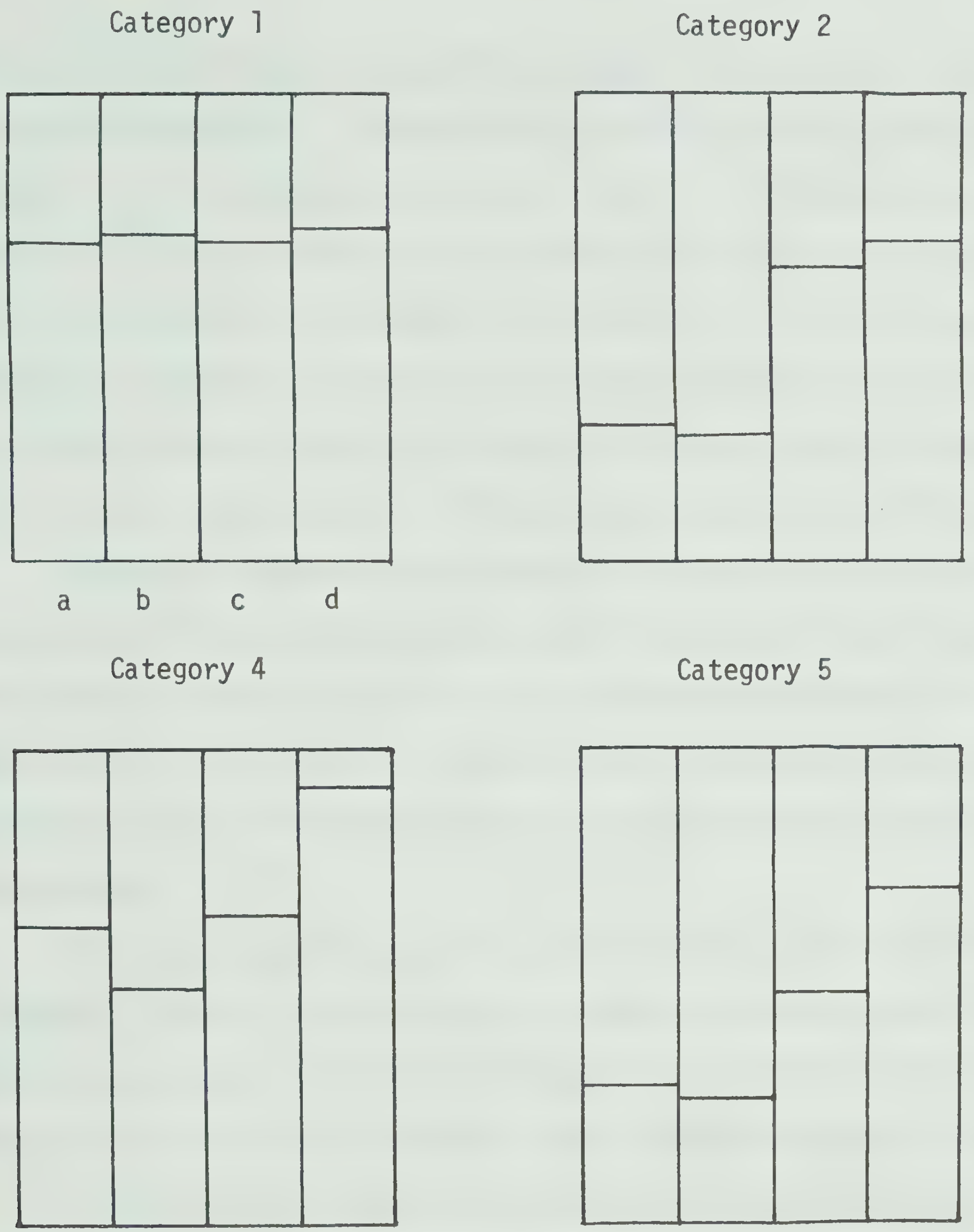

Figure 6. Categories of Individual Performance Profiles: Class 1A.

a. Baseline
b. Non contingent token reinforcement
c. Contingent social reinforcement
d. Contingent token + social reinforcement

performance brought about during the contingent token + social phase was comparatively minor. An individual reaction as equally widespread in class 1A is represented by Category 4 (fig. 6). The performance profile of a typical student in this category shows that contingent social reinforcement served merely to re-establish levels of on-task behavior and productivity which existed during the baseline period. Any increases above pre-existing baseline levels were minor in comparison with those effected by the contingent token + social condition.

Category 5 represents the profile of a student whose performance was significantly increased above baseline during the contingent social phase in class 1A (fig. 6) or the contingent token phase in class 1B (fig. 7). A further increase, equal in magnitude to the first, was effected during the ensuing phase of contingent token + social reinforcement.

The most frequently occurring profile in class 1B is represented by Category 3 (fig. 7). In this case a student's on-task behavior and productivity was most dramatically increased above baseline performance during the period in which contingent token reinforcement was in effect.

In conclusion, although performance profiles indicated considerable variation in the reactions of individual students to the different reinforcement conditions, it was possible to categorize these profiles on the basis of similarity of student reactions to these conditions.

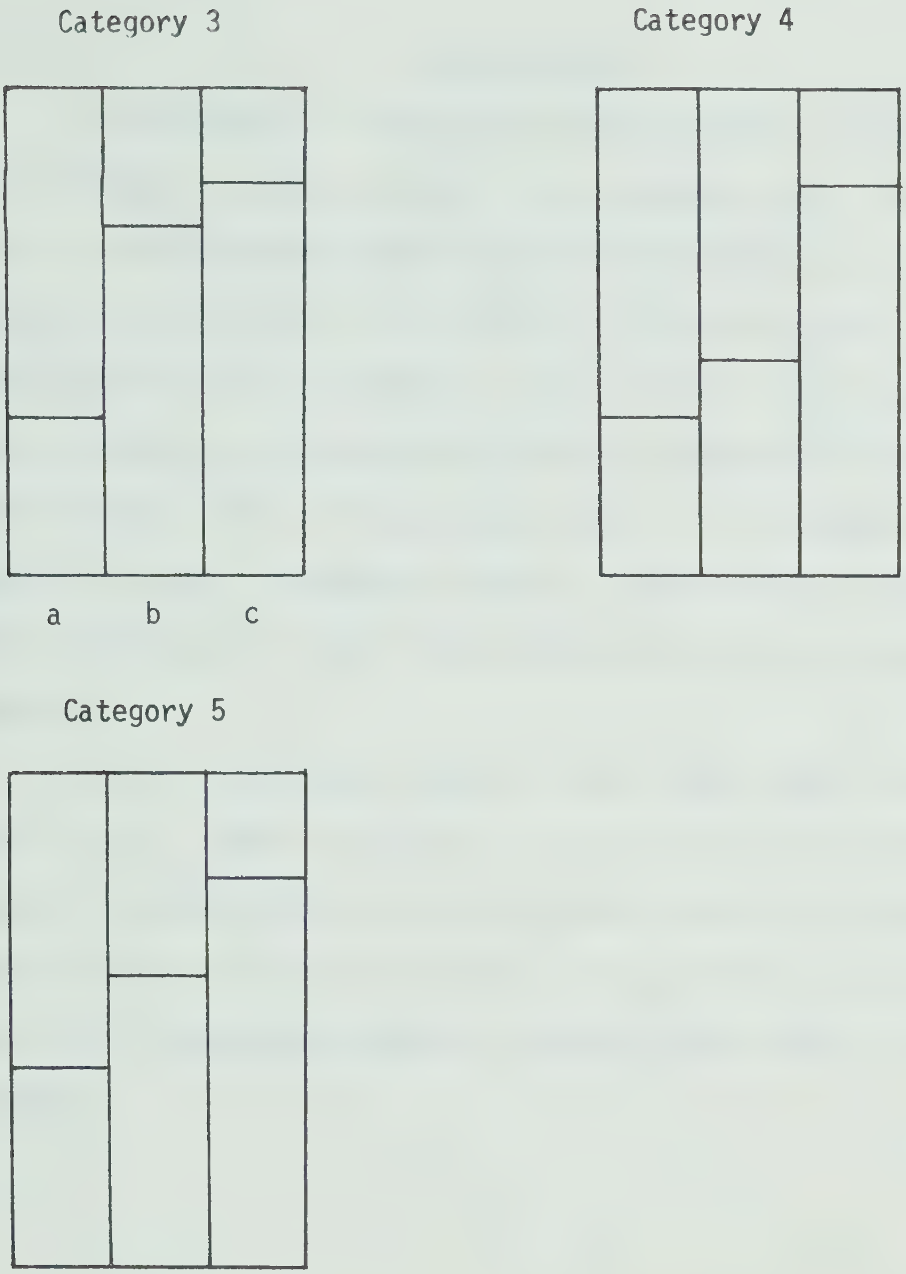

Figure 7. Categories of Individual Performance Profiles: Class 1B.

a. Baseline
b. Contingent token reinforcement
c. Contingent token + social reinforcement

FOLLOW-UP DATA

Unfortunately, a variation in the mathematics program restricted the assessment of generalization in the present study. Because the nature of the assignments had changed, on-task remained the only variable which could yield a valid measure of generalization. Post-experimental observations of students' on-task behavior were conducted at monthly intervals for two months after the completion of the project. Table 14 shows that after two months, the level of students' on-task behavior in class 1A remained superior to baseline performance, and approximately equal to mean level maintained under the contingent social condition.

Similar trends were evident in the observational data obtained from class 1B. After two months, on-task behavior was observed to be superior to maximum levels obtained during baseline and approximately equal to levels maintained under the contingent token condition. In conclusion, a respectable degree of generalization seems to have been achieved.

TABLE 14

RESULTS OF POST CHECKS FOR GENERALIZATION OF ON-TASK BEHAVIOR

Date	Class	Percent On-Task
January 20	1A	88
February 21	1A	85
January 20	1B	92
January 20	1B	89

CHAPTER 5

DISCUSSION AND IMPLICATIONS

Contingency Management and Classroom Ecology

Perhaps the most significant outcome of this study was that contingency management procedures were demonstrated to be important components in establishing a productive classroom environment. Experimental results of this investigation reaffirm the conclusion of Broden et al., (1965) and Hill (1970) that extrinsic reinforcement can be employed to strengthen on-task behavior and productivity. However, reports by Kortas (1970), Hewett et al., (1969), and Wolf et al., (1968), which claimed that extrinsic reinforcement enhanced academic accuracy, were not fully substantiated by this study.

In essence, the results of the study indicate that extrinsic reinforcement may be more effectively employed to increase the level of pre-existing behaviors such as on-task behavior than more cognitively orientated behavior over which the student has less intentional control.

Contingencies and Non-Contingencies

Confirmation of hypotheses two and three, which predict the superiority of contingent reinforcement over non-contingent reinforcement, lend support to the studies by Hart et al., (1968), Bushel et al., (1968) and O'Leary and Becker (1967). These authors reported

the value of contingent reinforcement over non-contingent reinforcement as an effective agent of behavioral change. Similarly, in the present study, behavior was significantly changed as a result of the contingent arrangement of consequences. Therefore the applicability of the behavioral engineering model in an applied setting has been effectively demonstrated.

Figure 10 constitutes a dramatic illustration of the way in which students' on-task behavior and productivity were differentially effected by contingent and non-contingent token reinforcement. The beneficial effect of contingent reinforcement was demonstrated with class 1B when the application of contingent token reinforcement caused on-task behavior and productivity to soar to a height never attained during baseline. An upward trend in the levels of both these behaviors continued throughout this contingent period.

The detrimental effect of the non-contingent strategy was clearly demonstrated when non-contingent token reinforcement was introduced to class 1A. At this time on-task behavior and productivity regressed to their lowest levels in the entire program. A downward trend on both these variables continued until the implementation of contingent social reinforcement caused a reversal in this trend. Results for both classes indicate that each of the three contingent reinforcement strategies used in the study maintained higher levels of on-task behavior and productivity than were maintained during the baseline period. These results clearly demonstrate the advantage of using contingent reinforcement procedures to enhance learning in the classroom

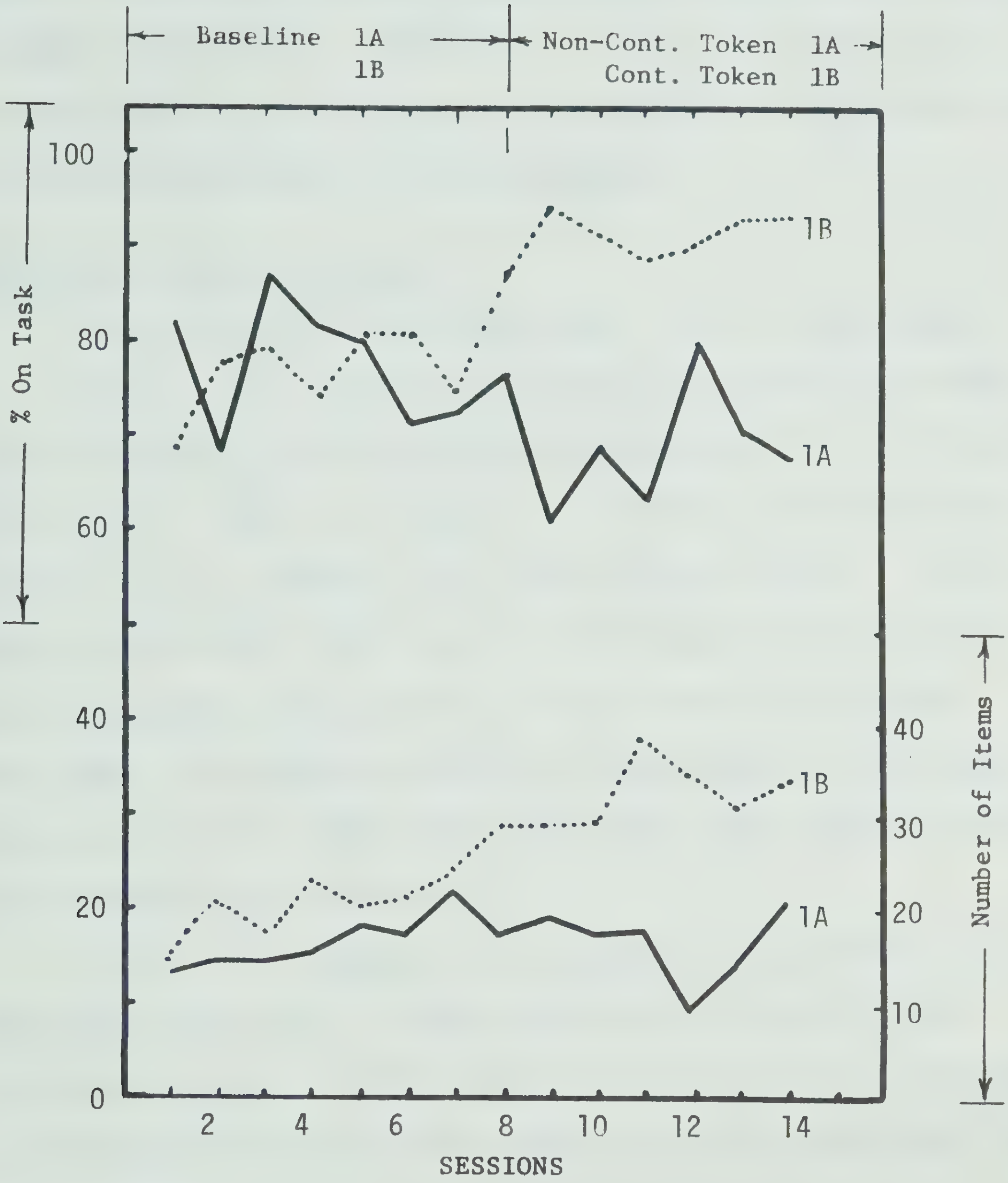

Figure 8. A daily record of on-task behavior and productivity for class 1A (solid line) during baseline and non-contingent token conditions, and class 1B (dotted line) during baseline and contingent token conditions.

setting. In addition, they add credence to the criticism that teachers who employ non-contingent reinforcement in their classrooms may be adversely affecting the development of appropriate classroom behaviors and thereby be defeating their own objectives.

Components of the Total Program

The superiority of contingent token + social reinforcement over contingent social reinforcement alone in maintaining desirable classroom behaviors, has been reported by Birnbrauer et al., (1965), O'Leary et al., (1969), and Broden et al., (1970). Confirmation of hypothesis 8 in the present study sustains these findings. It was shown that contingent token + social reinforcement elevated on-task behavior to a level not previously attained during the contingent social phase. At no time during the contingent token + social phase did on-task behavior regress below the optimum level achieved during the contingent social condition.

Prior to the inception of this project, the influence of token reinforcement had only been researched in conjunction with social reinforcement. In this study, provision was made to investigate the effectiveness of token reinforcement in isolation from other forms of reinforcement.

Results indicate that contingent token reinforcement alone was responsible for maintaining improved levels of on-task behavior and productivity. In class 1B,levels of on-task behavior and productivity were dramatically increased over baseline by the introduction of contingent token reinforcement. Therefore tokens alone, without the aid

of social reinforcement, were responsible for bringing about quick and effective changes in behavior.

It should be noted that the results of this study, which demonstrate the potency of contingent token reinforcement alone in changing classroom behavior, constitute an addition to the growing body of applied behavioral research.

Although both contingent social reinforcement and contingent token reinforcement served to promote significant increases in on-task behavior and productivity, results show that the combined strategy of contingent token + social reinforcement constituted the most powerful condition used in the project.

The Multiple Baseline Design

The multiple baseline design was employed to determine the effectiveness of the different experimental procedures used in this study. Because this design has been so infrequently reported in the literature, an evaluation of its utility in the present project seems warranted.

The multiple baseline design extended the scope of this study because it enabled the teacher to assess whether three classes of students' behavior were independently affected by each of the five experimental conditions. The project could not have been completed in the time available if the traditional reversal (A.B.A.) design had been employed.

The multiple baseline design was successful in showing the rapid changes which took place in on-task behavior and productivity

at the point where new experimental conditions were introduced. Results indicate that on-task behavior and productivity appeared to be relatively independent of each other with one exception. At one point in the program, productivity levels of classes 1A and 1B seemed to be prematurely influenced by a concurrent increase in on-task behavior. This effect occurred at that point in the program where on-task behavior was most dramatically increased. These results indicate that moderate changes in on-task behavior did not cause a corresponding fluctuation in students' productivity. It could be assumed therefore that the efficiency of students' work does vary, and that there is not always complete correspondence between the amount of time spent on a task and the amount of work completed.

Because the multiple baseline design incorporated a staggered introduction of experimental conditions, there were sessions when two separate behaviors were each subject to a different experimental condition. The brief two-day latency period proved to be one limitation of the design. Because of this complexity, the teacher found it necessary to use large daily memos to ensure that experimental conditions were implemented according to the design. Although the staggered schedule called for precision, the task of following the multiple baseline required no greater competence than that possessed by the average teacher.

In conclusion, the multiple baseline design employed in this study enabled economical investigation of the effect of different reinforcement conditions upon discreet classes of student behavior without requiring the teacher to revert to pre-experimental behavior in

order to simulate baseline conditions.

Follow-up Data

Perhaps the most valid question to be answered after a reinforcement program has been in operation is whether or not the newly acquired behaviors have made their appearance in situations outside the one in which they were developed. Generalization is often expected as a consequence of contingency management programs. However, O'Leary et al., (1969, p.13) caution that "generalization is no magical process but rather a behavioral change which must be engineered like any other change."

Post-checks carried out up to two months after the completion of the projects revealed that relatively high levels of on-task behavior were being maintained in both classes. This data may lead one to infer that generalization has taken place. However, these results should not be accepted without question.

Hewett et al., (1969) reported that desirable work habits developed during a token reinforcement were maintained after tokens had been removed. A similar report by Broden et al., (1970) claimed that high rates of study behavior were maintained up to six weeks after tokens had been discontinued. Interestingly enough, in the same study, Broden et al., (1970) reported that, although desirable rates of study behavior were maintained during the first lesson of the day when token reinforcement was in effect, there was no generalization of this behavior into any other lesson of the day. The generalization reported in this study, and in studies by Hewett et al., (1969), and

Broden et al., (1970), was observed in situations where contingency management programs had been formerly carried out.

Discriminative stimuli specific to these experimental situations were no doubt responsible in part for this generalization. In addition, the frequency of positive reinforcement awarded by the teacher could have increased as a result of the desirable outcomes brought about by the use of contingent social reinforcement in the project.

In view of this, it seems unreasonable to expect generalization of behavior to occur in other situations unless special provision is made for it to do so. The technologies of stimulus control and contingency management should be used to facilitate generalization of newly acquired behaviors.

IMPLICATIONS

For Future Research

Because the study was initiated and carried out by a classroom teacher with his own students, the possibility of the teacher's expectations having biased the experimental results (Rosenthal, 1963) cannot be overlooked. In view of this, the results of the study should be tentatively accepted until such time as a systematic replication is undertaken to confirm these findings.

As this study was being reported, the need for replicability was borne in mind. For this reason, particular attention was paid to the suggestion by Baer et al., (1968, p. 95) that experimental procedures should be reported clearly enough to enable a "typically

trained reader to replicate the procedure." Because this study was carried out in a school for E.M.R. pupils where the student-teacher ratio was approximately fifteen to one, it would seem reasonable to question whether the results obtained in this instance are applicable to other educational settings. Therefore, it is hoped that systematic replications of this study will be carried out in both regular and special educational settings, with pupils of different ages and varying ability, to determine whether the results obtained in this study possess true external validity.

It can be seen from an inspection of the data that there was considerable variation in the reaction of individual students to different reinforcement conditions. Similar individual reactions to the addition and removal of extrinsic reinforcers were reported by Birnbrauer et al., (1965), and Broden et al., (1970).

Although a systematic analysis of these individual differences was beyond the scope of this thesis, the emergence of individual patterns does suggest the importance of future research in this area. Results obtained from such studies could enable teachers to strategically tailor reinforcement to optimize individual student performance.

Although no empirical evidence is available to support the following impression, it became apparent during the final phases of the study that students' excitement was highest when token stamps were being awarded. This finding has led the classroom teacher to question whether the competition involved in working for tokens became intrinsically rewarding or whether the excitement produced was merely in

anticipation of back-up reinforcers. This study suggests the need for further investigation into the value of competition as a rewarding consequence.

Practical limitations prevented a thorough assessment of the generality of on-task behavior and productivity in this project. Future replications should make provision for follow-up data to be collected in situations which differ from the original experimental setting. In this way "across situational" generality may be more effectively studied to determine what special provisions have to be made to facilitate the transfer of newly acquired behavior.

For Classroom Management

Positive reinforcement was the only contingency management procedure employed in the project to facilitate desirable classroom behaviors. The temptation to resort to traditional aversive methods, such as the withdrawal of privileges or the imposition of criticism, was subdued by the overriding concern to reinforce only desirable behavior and to ignore undesirable forms of behavior. In spite of the frequent outspoken criticism of contrived reinforcement programs in other settings, the effectiveness of positive control in this classroom study has far-reaching implications for classroom practice and for society in general. Schools have traditionally relied too heavily upon aversive methods to achieve educational goals.

For Teacher Preparation

The results of the study appear to have particular relevance to the preparatory training of student teachers as well as to the

continuing professional development of practising teachers.

It has been traditional to explain good teachers as those who have acquired the "tricks of the trade" through years of experience. This belief will not be disputed. However, as Hanley (1970) points out, it is more difficult to teach tricks than to teach principles. Principles are fewer, more easily learned and will generate tricks when appropriately applied. In view of this it would seem most economical to provide student teachers with a sound background of the principles of stimulus control and contingency management. However, the knowledge of these principles alone will not ensure their utilization in the classroom setting. Consequently it is recommended that students also receive first hand experience in applying these principles to modify behavior. Learning theory lends little support to the convenient saying that "you cannot teach an old dog new tricks." Because age and teaching experience have little to do with the effective use of behavioral principles, the provision for behavior modification inservice programs for experienced and inexperienced teachers alike, should be considered.

For Teaching Practice

Campbell and Stanley (1970, p. 21) have indicated that "experiments within the schools must be conducted by regular staff . . . especially when findings are to be generalized to other classroom situations." It is frequently overlooked that the tasks of researcher and teacher often differ only in degree. Teachers make use of various teaching methods, they conduct tests to evaluate ensuing changes in

behavior, and then use these results to plan future outcomes. Classroom teachers have tended to avoid rigorous experimental research because normal teacher preparation does not equip them to carry out such undertakings alone. The completion of this study bears witness to the fact that rigorous action research can be carried out by a practising classroom teacher working in close liaison with a specialist in research methodology. It is the writer's sincere hope that this project may provide the impetus for closer cooperation between teacher and researcher so that more immediate action will be forthcoming from the copious research that is conducted in our schools today.

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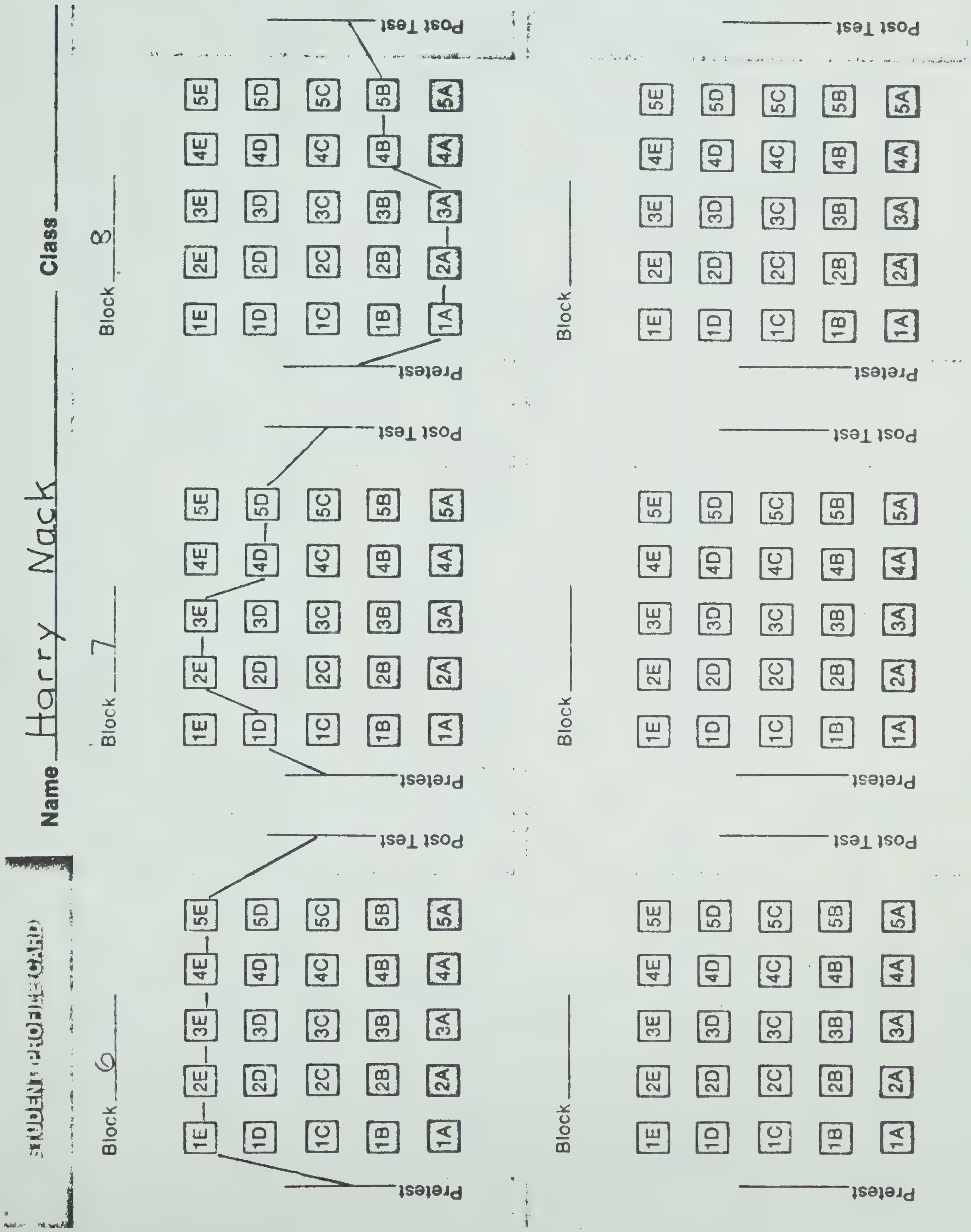
APPENDICES

APPENDIX A

An Individualized Math Progress Card



STUDENT PROFILE CARD

Name Harry Nack **Class**

Block 6

Pretest

1E	2E	3E	4E	5E
1D	2D	3D	4D	5D
1C	2C	3C	4C	5C
1B	2B	3B	4B	5B
1A	2A	3A	4A	5A

Post Test

Block 7

Pretest

1E	2E	3E	4E	5E
1D	2D	3D	4D	5D
1C	2C	3C	4C	5C
1B	2B	3B	4B	5B
1A	2A	3A	4A	5A

Post Test

Block 8

Pretest

1E	2E	3E	4E	5E
1D	2D	3D	4D	5D
1C	2C	3C	4C	5C
1B	2B	3B	4B	5B
1A	2A	3A	4A	5A

Post Test

Block ______

Pretest

1E	2E	3E	4E	5E
1D	2D	3D	4D	5D
1C	2C	3C	4C	5C
1B	2B	3B	4B	5B
1A	2A	3A	4A	5A

Post Test

Block ______

Pretest

1E	2E	3E	4E	5E
1D	2D	3D	4D	5D
1C	2C	3C	4C	5C
1B	2B	3B	4B	5B
1A	2A	3A	4A	5A

Post Test

Block ______

Pretest

1E	2E	3E	4E	5E
1D	2D	3D	4D	5D
1C	2C	3C	4C	5C
1B	2B	3B	4B	5B
1A	2A	3A	4A	5A

Post Test

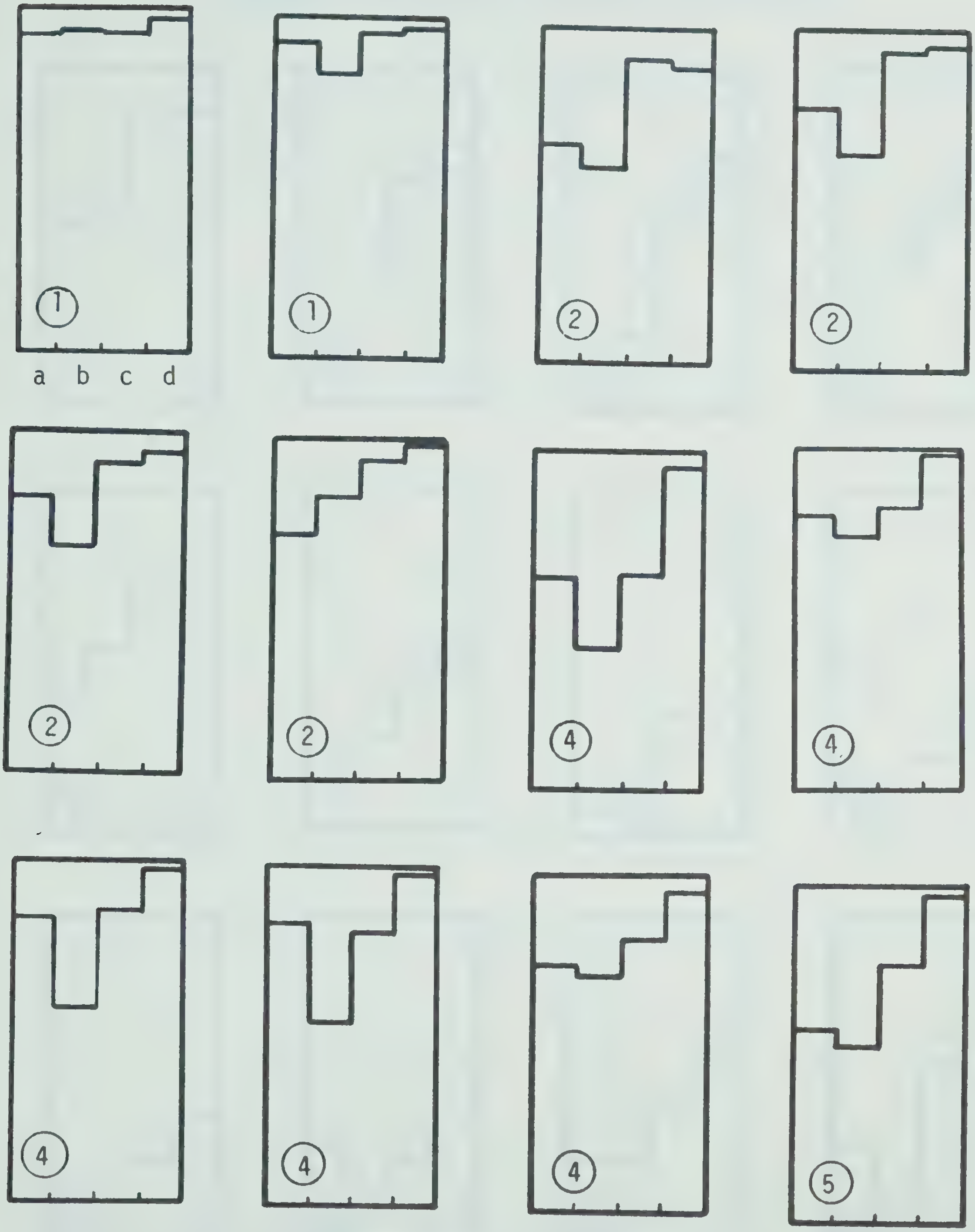
APPENDIX B

A Student's Worksheet

Lesson ___ ①	Block ___ ⑥	Name ___ ⑪	Date ___ ⑯
②	⑦	⑫	⑰
③	⑧	⑬	⑱
④	⑨	⑭	⑲
⑤	⑩	⑮	⑳

APPENDIX C

Individual Performance Profiles for Class 1A.
On-task Behavior Across Experimental Conditions

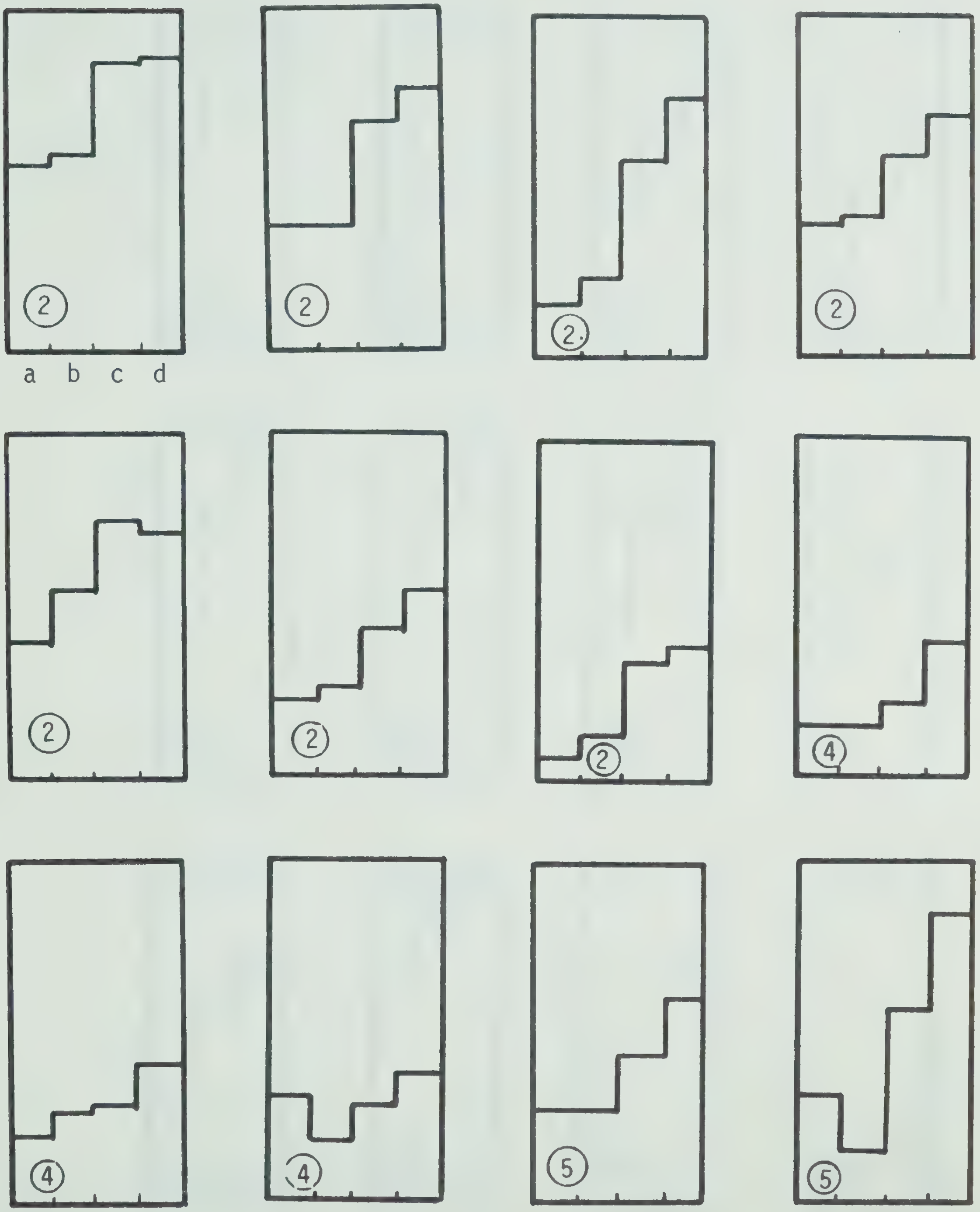


a. Baseline
b. Non contingent token reinforcement
c. Contingent social reinforcement
d. Contingent token + social reinforcement

[illegible]

APPENDIX D

Individual Performance Profiles for Class 1A. Productivity Across Experimental Conditions



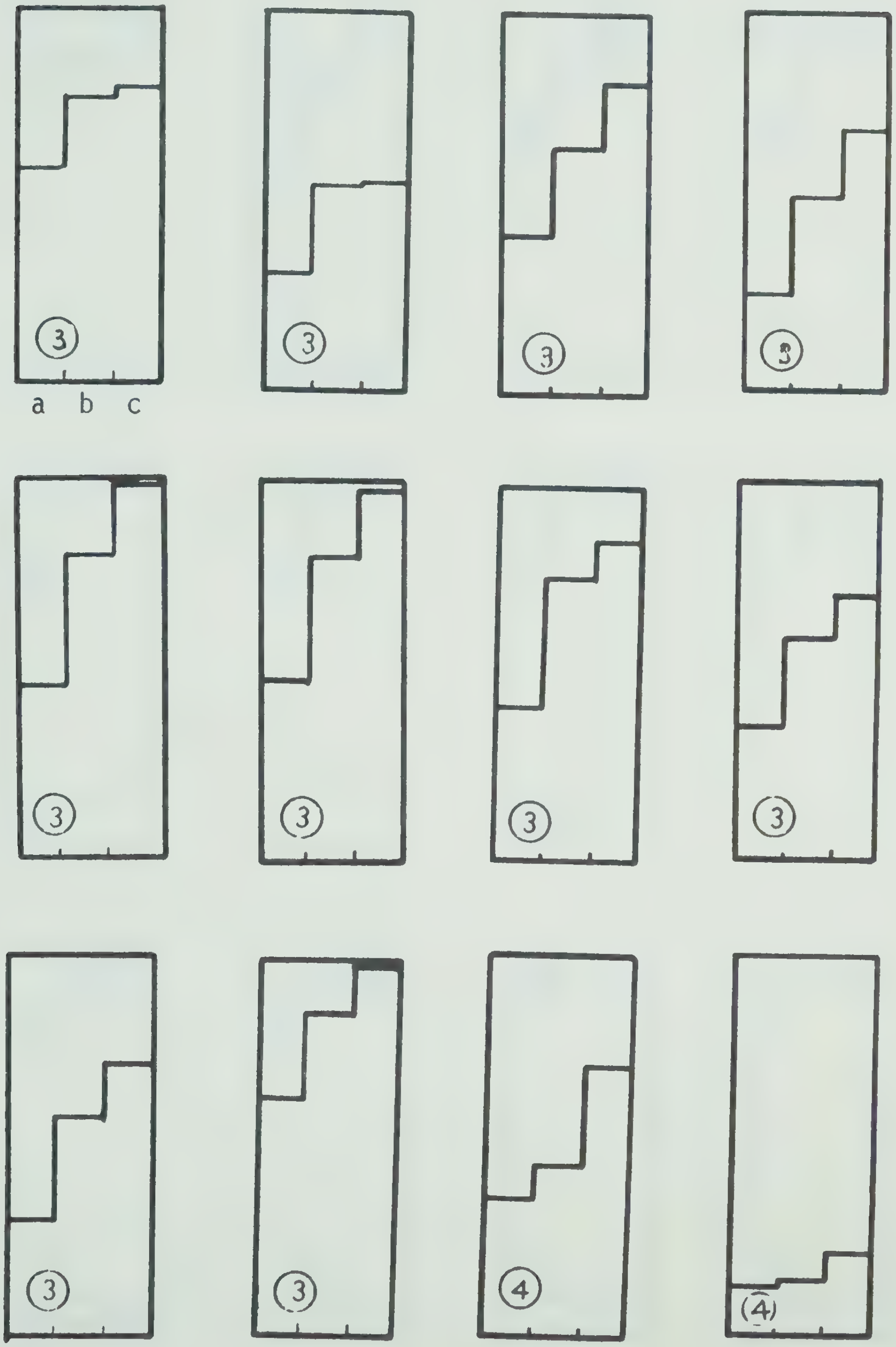
a. Baseline
b. Non contingent token reinforcement
c. Contingent social reinforcement
d. Contingent token + social reinforcement

[illegible]

[illegible]

APPENDIX E

Individual Performance Profiles for Class 1B.
On-task Behavior Across Experimental Conditions



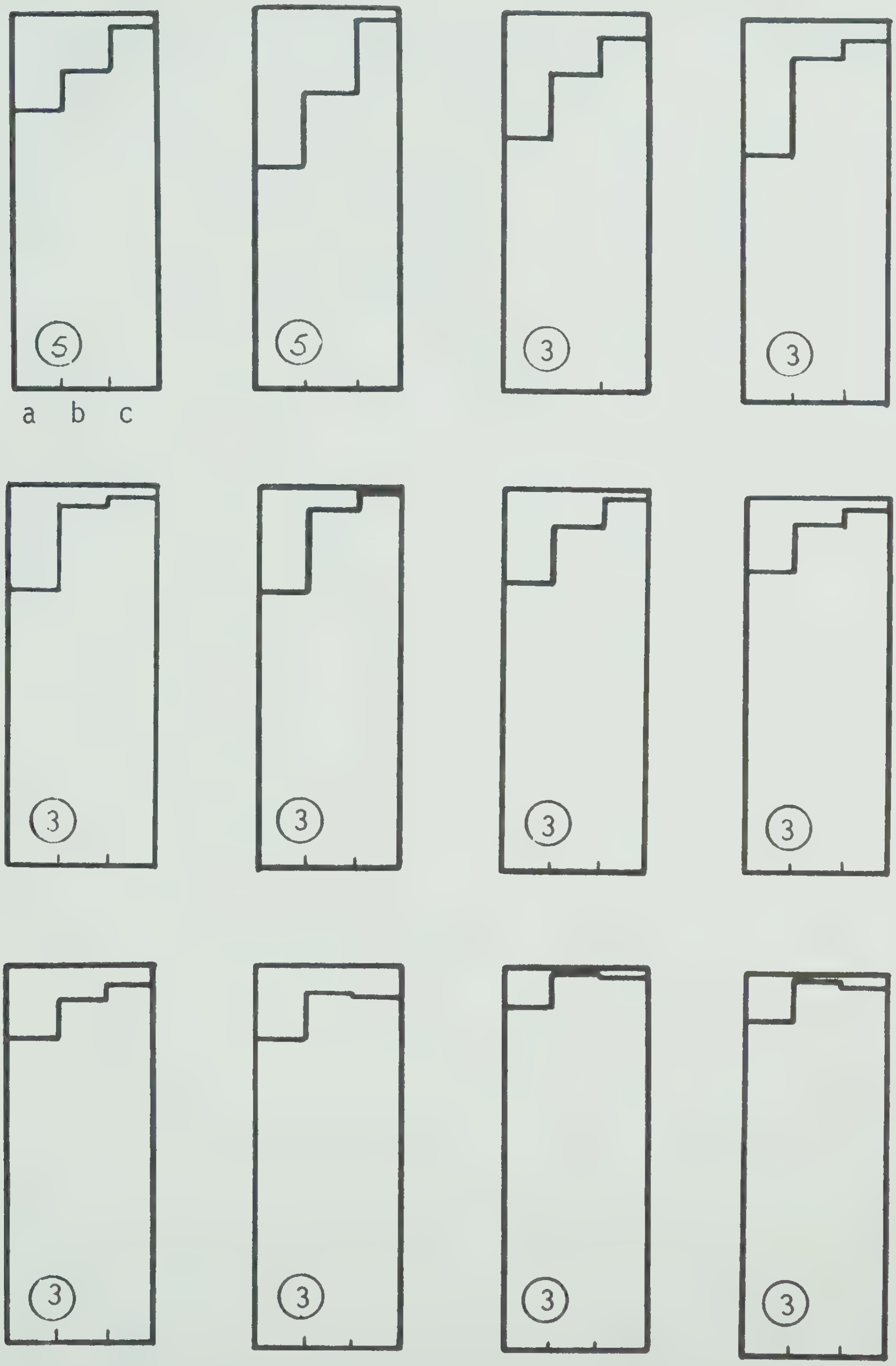
a. Baseline
b. Contingent token reinforcement
c. Contingent token + social reinforcement

[illegible]

[illegible]

APPENDIX F

Individual Performance Profiles for Class 1B.
Productivity Across Experimental Conditions



a. Baseline
b. Contingent token reinforcement
c. Contingent token + social reinforcement